general catalog

Solid education

SOLID EDUCATION

Georgia Institute of Technology

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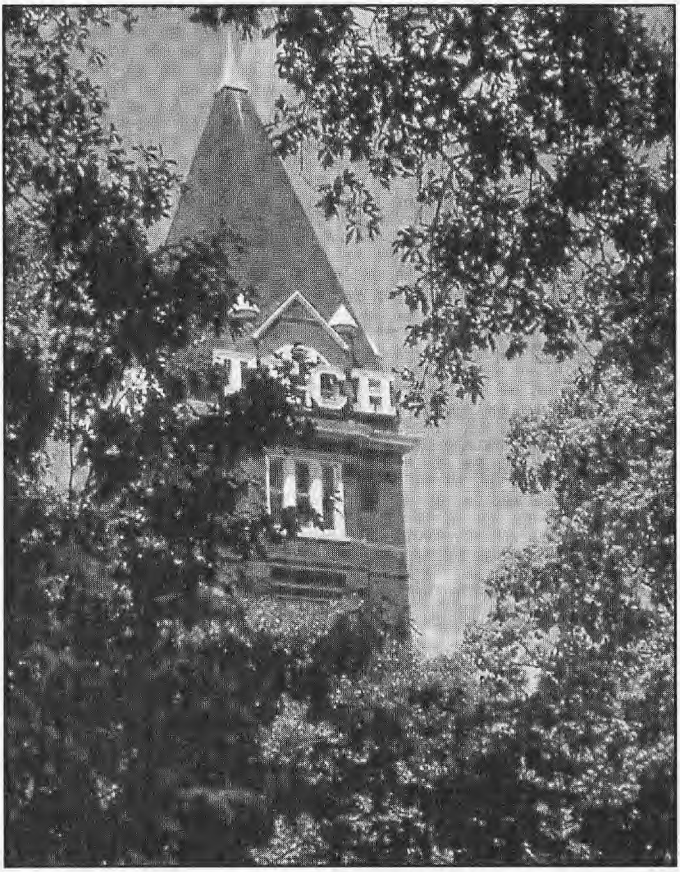

General Catalog 1999-2001
Georgia Institute of Technology
Atlanta, Georgia
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Contents

Georgia Tech: The Vision Statement

Georgia Tech will be a leader among those few technological universities whose alumni, faculty, students, and staff define, expand, and communicate the frontiers of knowledge and innovation. Georgia Tech seeks to create an enriched, more prosperous, and sustainable society for the citizens of Georgia, the nation, and the world.

Statement on Human Relations

Georgia Tech is a diverse community, composed of individuals and groups with a variety of religious, racial, national, cultural, sexual, and educational identities. The continuing need to deal constructively with this diversity is one of the great challenges facing us over the next two decades.

The challenge is both professional and personal. Professionally, we increase the opportunities in our lives if we are able to constructively manage and guide such diversity with tolerance. The challenge is also personal because each of us has a legacy of religious, racial, national, cultural, sexual, and educational prejudices that influences our lives.

Each member of our community must be committed to the creation of a harmonious climate because one cannot be neutral to this challenge. Those who are committed to it strengthen Georgia Tech and themselves.

Individuals who choose not to commit to the challenge, via acts of intolerance, jeopardize their continued affiliation with the Institute. Those acts may be defined as attempts to injure, harm, malign, or harass a person because of race, religious belief, color, sexual orientation, national origin, disability, age, or gender.

To belong to a global society, Georgia Tech must be a pluralistic institution. Only by embracing diversity, multiformity, and variety can we gain stature, strength, and influence in that global society.

The Institute is committed to maintaining academic and working environments free of objectionable conduct and communication that would be construed as sexual harassment. The determination of what constitutes sexual harassment will vary with particular circumstances, but it can be described as unwanted sexual behavior, such as physical contact or verbal comments that adversely affect the environment of an individual.

Academic Calendar 1999-2000; 2000-2001

Beginning with the fall term of 1999, Georgia Tech will operate on the semester plan, with the fall and spring terms constituting the academic year. An abbreviated summer term schedule will offer students the opportunity to accelerate or catch up in their program of study. Students normally matriculate in fall term. A commencement ceremony will be held at the end of the fall and spring terms; however, students may complete their program of study during any one of the academic terms.

The Office of the Registrar prepares and distributes an official Institute calendar for each term. Dates, filing times, deadlines, and other information contained in the official calendar supersede previously published information, including notices in this catalog. Adherence to the dates set by the official calendar is the responsibility of the student. For further information, visit the registrar's webpage at: www.registrar.gatech.edu

Tentative Calendar

Summer Term 1999

June 12	Spring Commencement
June 18	Late registration
June 21	Classes begin
July 5	Holiday
August 6	Last day of classes
August 9-11	Final exams
August 13	Commencement
August 14	End of term

Fall Term 1999

August 20	Late registration
August 23	Classes begin
September 6	Holiday
October 18-19	Mid-term recess
November 24-26	Thanksgiving recess
December 10	Last day of classes
December 13-17	Final exams
December 18	End of term; Commencement

Spring Term 2000

January 7	Late registration
January 10	Classes begin
January 17	Holiday
March 6-10	Spring break
April 28	Last day of classes
May 1-5	Final exams
May 6	End of term; Commencement

Summer Term 2000

May 15	Late registration
May 16	Classes begin
May 29	Holiday
July 4	Holiday
July 28	Last day of classes
July 31-August 2	Final exams
August 5	End of term

Fall Term 2000

August 18	Late registration
August 21	Classes begin
September 4	Holiday
October 16-17	Mid-term recess
November 22-24	Thanksgiving recess
December 8	Last day of classes
December 11-15	Final exams
December 16	End of term; Commencement

Spring Term 2001

January 5	Late registration
January 8	Classes begin
January 15	Holiday
March 5-9	Spring break
April 27	Last day of classes
April 30-May 4	Final exams
May 5	End of term; Commencement

Summer Term 2001

May 14	Late registration
May 15	Classes begin
May 28	Holiday
July 4	Holiday
July 27	Last day of classes
July 30-August 1	Final exams
August 4	End of term

A Solid Education For a Successful Future

In today's competitive world, the nation's top employers and graduate schools are looking for college graduates with a keen understanding of the power of technology—and the skill to use and manage it effectively. To excel in that type of environment, students need not only a solid grounding in cutting-edge technology, but also a well balanced college education that enables them to build rich professional and personal lives.

The Georgia Institute of Technology is internationally recognized for providing one of the best educational experiences available anywhere in the world. Studying in state-of-the-art, nationally ranked laboratories and working through a co-op or internship program to gain hands-on career experience are just two of the advantages that Georgia Tech can offer.

Choosing Georgia Tech, however, means much more than earning a top-notch, technologically focused degree. What makes a Georgia Tech education uniquely valuable is the comprehensive college experience that comes with it. Courses in areas such as management, international affairs, public policy, and psychology are open to all Tech students, even those pursuing scientific or technical degrees. In addition, opportunities with campus activities outside the classroom are vast. Student government, recreation, fraternities and sororities, publications, radio, theater, honor societies, and community service are just a few of the areas where students can not only participate, but also play a leadership role.

Georgia Tech offers a solid, first-rate education that helps students become highly marketable professionals and well rounded human beings.

Excellence in Education

The quality of the Georgia Tech educational experience is reflected in two important ways: consistently strong rankings by national publications and a prestigious, highly regarded curriculum with a technological focus.

In 1998, Georgia Tech was ranked Number 13 among public universities in the country by *U.S. News & World Report,* which also listed several of Tech's undergraduate programs in the top 10 during the late 1990s.

Georgia Tech is also renowned for providing a highly diverse educational environment. The Institute consistently ranks among the top universities in the country in the number of engineering degrees awarded to women, African Americans, and all underrepresented minorities.

Tech's high-quality faculty is another key contributor to the Institute's educational environment. More than 90 percent of the faculty hold Ph.D.s and more than 55 faculty members have received the prestigious National Science Foundation CAREER Awards. Tech's prominent faculty are recognized worldwide for their excellent research and teaching skills.

Both faculty and administrators help to ensure that the Georgia Tech curriculum reaches far beyond the scope of traditional major classes with programs that provide a competitive career advantage. Many forward thinking students choose to participate in the Cooperative Plan at Tech, an alternating work/study program that is the largest voluntary program of its kind in the United States. More than 3,500 students (approximately one-third of Tech's student population) participate in this program. Students enjoy co-op not only because they receive valuable work experience, but also because they are paid for their work.

For students who want a more flexible program, internships are available with a wide variety of employers. Regardless of whether students choose a co-op or internship position, or pursue a preprofessional program to prepare for graduate or professional school, Tech helps students lay the groundwork for a successful future.

Leadership in Research

From its beginnings more than a century ago, the Georgia Institute of Technology has established a tradition of excellence in technological research as well as education. The Institute is well known for its high academic standards and stands among the top ranks of U.S. research universities with a clear vision for leadership in providing a technological education into the next century.

Our peers and the public recognize Georgia Tech's commitment to excellence. Georgia Tech is the South's largest industrial and engineering research agency. Research is conducted for industry and government by the Georgia Tech Research Institute, various academic schools and departments, and more than 55 interdisciplinary research units on and off campus. In Georgia specifically, the Institute plays a leading role in the Georgia Research Alliance (GRA), a centerpiece of the state's economic development strategy. In 1996, the GRA completed construction of the Georgia Center for Advanced Telecommunications Technology (GCATT) building, a facility that houses several Georgia Tech research centers as well as research centers from other universities, high-tech business incubators, and established telecommunications businesses. The GCATT partnership of academia, industry, and government is helping propel Georgia's telecommunications industry to world prominence.

By insisting the Institute's major interdisciplinary research centers—focusing on topics from architectural conservation to biotechnology, microelectronics, and transportation research—also develop distinct undergraduate and graduate educational programs, the Georgia Tech administration intends to keep its educational programs on the leading edge of discoveries and developments. Students have access to Tech's marine research facility at Skidaway Island off the Georgia coast, the Oak Ridge Nuclear Laboratories in Tennessee, and the global telecommunications activities at the Georgia Tech Lorraine campus in Metz, France.

An Enriching Campus Atmosphere

Many students cite the interactive learning atmosphere at Georgia Tech as one of the primary benefits of attending the Institute. Through hands-on learning experiences such as labs, field studies, and team projects, Tech students are prepared for the real world. Continued recruitment and job placement of high-quality students is also an advantage that many gain from attending Georgia Tech. The Placement Center is one of the nation's most successful and innovative. At the 1998 spring commencement, approximately 70 percent of the students receiving their diplomas had already accepted a job or been accepted to graduate school. In 1997-98, employers made more than 1,200 visits to campus, conducting more than 16,000 student interviews.

Tech's administration and staff emphasize student services as well as academics. Centralized student services, the Student Success Center, and renovated and new residence halls are some of the efforts to further enhance the quality of life on campus. The strong work ethic at Tech is balanced by a collegiate atmosphere incorporating both intercollegiate and intramural sports, campus traditions, and approximately 250 student organizations. Alongside their academic achievements, Tech students are also active in the community, earning a well rounded education through community service activities.

To become even more effective in a rapidly diversifying world, Tech is aggressively recruiting underrepresented populations. The Institute is consistently rated among the top universities in the nation for graduation of underrepresented minorities in engineering-technology/computer science/mathematics. Each year the number of minority and female students continues to grow—ensuring that Tech's students will be ready to thrive in the multicultural workforce.

As the modern research university continues to evolve, Georgia Tech is dedicated to continuing its proud tradition of providing a solid college education leading to a successful future. As part of our bid to become one of the nation's premier research universities, we are engaged in a Capital Campaign to raise funds to fulfill the Institute's strategic goals and objectives. Equipped with the extremely rich resources of an outstanding student body and faculty; strong partnerships with business, industry, and government; and support from alumni and friends, Georgia Tech is poised to fulfill its goals, as well as meet and exceed the challenges of the next century.

Semester Conversion at Georgia Tech

Semesters at a Glance

In accordance with a University System of Georgia Board of Regents' decision that the entire System convert to the semester calendar, Georgia Tech will begin operating on a semester calendar in fall 1999. The semester system reorganizes the four-quarter academic calendar into two semesters and a summer session. While quarters at Tech consist of 10 weeks of classes and a week of final exams, each semester will have approximately 15 weeks of classes, plus a break or breaks totaling one week during the term, plus exams. The summer session will have 11 weeks of classes, plus exams. The fall semester begins in late August and ends in mid-December. The spring semester begins in early January and ends in early May. The summer term begins in mid-May and ends in early August. (Tentative calendars through Summer 2001 can be found on page 4.)

Tech's Promise to Students in the Transition

Students who will be completing their degrees during the change-over (and that means anyone who does not graduate before fall 1999) may be concerned about getting caught in the transition. The administration and faculty are committed to minimizing any problems that might arise out of the articulation between degree requirements under the two systems.

This is our promise to you:

•Georgia Tech will make every effort to ensure that students are not penalized by the conversion from quarter to semester calendars.

•Converting to semesters should not delay the graduation date, since the numbers of hours are proportionally the same.

•There will be no loss of earned credit as a result of the change.

•Credit for courses taken under the quarter system will be converted to semester hours and counted toward degree requirements, if they were previously appropriate and if no change of major and degree occurs.

•Academic advising within the schools will be expanded during the conversion process.

•Prior to the conversion, each student should have in hand a written statement of the courses needed to complete the degree requirements of their chosen major under the semester system. In cases where converting a student's program of study requires substitution of courses for some of those in the set of courses required for his or her major, the substitutions will be made as part of the advising process in the student's school, rather than by petition to the Institute faculty, as is now the case. Such individual substitutions will be reviewed by the Registrar's Office and entered into a student's academic record.

Frequently Asked Questions

Q. What will happen to the Co-op Program?

A. The opportunities for work and study under the Co-op Program will be as strong as ever, although the work-study rotation will necessarily be different due to the odd number of terms in the school year. Under the semester system, students will follow a three-term rotation in which every co-op student will rotate through all academic terms during their co-op careers. For example, in one calendar year a student might work spring semester (January-May) and fall semester (August-December) and be in school for the summer semester (May-August). The next year the same student would attend classes in the spring and fall, working in the summer. A detailed equivalency chart of the quarter and semester programs is available from the Co-op Office.

The summer term is being planned with the needs of co-op students in mind. Most schools that offer co-op degrees will continue to teach all the required courses during the summer. Some of the smaller schools are not currently able to offer all required courses every term, but the Co-op Office will continue to work with students on an individual basis to ensure that they can continue to work as co-ops and complete their academic requirements. Even though the summer academic term will be only 11 weeks as opposed to 15 in the fall and spring, co-op students will be able to take a full load. After the shift to semesters, students who complete all of their work and academic requirements with a combination of semesters and quarters will be awarded their co-op degrees. Flexibility will be the key word during the transition years.

Q. What are the financial implications for students?

A. Tuition and fees for the academic year will not increase because of the conversion, although they will be proportionately higher for each 15-week semester than for each 10-week quarter.

The change to semesters will not affect the amount of financial aid received by a student. As an example, say that an eligible fourth-year undergraduate may have a Stafford Loan of \$5,500. Under the quarter system, the student receives a third of the loan (\$1,853) per quarter. Under the semester system, the student will receive half of the loan (\$2,750) per semester.

There is one wrinkle in the change-over. For students attending summer/fall/winter/spring of 1998-99 and the summer quarter of 1999, there will be no federal funds available (Pell, Perkins, SEOG) for the summer quarter of 1999. With the shift to semesters, the current financial aid "award cycle" of summer/fall/winter/spring will change to fall/spring/summer. The change in the award cycle will not affect the priority date (April 15) by which students are asked to file their financial aid applications for the next academic year. The Office of Student Financial Planning and Services will work with students to facilitate the transition.

Q. How do I convert my credit hours, quality points, and GPA?

A. To find the semester GPA hours, earned hours, and quality points, multiply your quarter GPA hours, earned hours, and quality points by 2 and divide by 3, rounding to 2 places. The GPA is computed by dividing total quality points by total GPA hours, just as in the quarter system.

Office of the Vice Provost for Undergraduate Studies and Academic Affairs

Academic Offerings

Through the colleges of Architecture, Computing, Engineering, Management, and Sciences, and the Ivan Allen College, Georgia Tech offers curricula leading to degrees in 30 undergraduate majors, 38 master's programs, and 27 doctoral programs as well as preparatory programs for law, dental, medical, and veterinary schools. The "Information for Undergraduate Students" and the "Information for Graduate Students" sections of this book contain general information about these degree programs.

Accreditation

The Georgia Institute of Technology is an accredited member of the Southern Association of Colleges and Schools, and many programs within the Institute are specifically accredited by appropriate national certifying agencies. The Accreditation Board for Engineering and Technology (formerly the Engineers' Council for Professional Development) has awarded accreditation to the four-year engineering curricula leading to bachelor's degrees in the following fields: aerospace engineering, chemical engineering, civil engineering, computer engineering, electrical engineering, industrial engineering, materials engineering, mechanical engineering, nuclear and radiological engineering, and textile engineering and to the graduate programs leading to the master's degree in environmental engineering. The American Chemical Society has certified the curriculum leading to the bachelor's degree in chemistry; the Computer Science Accreditation Board has certified the curriculum leading to the bachelor's degree in computer science; the National Architecture Accrediting Board has certified the curriculum leading to the Master of Architecture; and the American Assembly of Collegiate Schools of Business has accredited the curricula leading to the Bachelor of Science in Management and the Master of Science in Management. The Counseling Center is accredited by the International Association of Counseling Services.

Student Life

Numerous extracurricular activities are available for students. For complete information concerning these services, see the *Guide to Student Life*, available to all students from the Division of Student Affairs.

Office of the Dean of Students

The Office of the Dean of Students, a unit of the Division of Student Affairs, strives to create an environment in which student leadership occurs, tradition and diversity are respected, and learning is enhanced. The dean's offices recognize the importance of each individual student, nurture personal growth, and support academic pursuits through advocacy, services, and programs.

Students of nontraditional age (over the age of 25) who would like information regarding campus resources, such as housing and other specific services, may call the dean's office for assistance.

Information on other areas within the Office of the Dean of Students can be found in various sections of this catalog. The office is located in 210 Smithgall Student Services Building. Students may drop in or call (404) 894-6367 to schedule an appointment.

Community Services

Georgia Tech applies its resources through community services to the needs of the community and provides an outlet for creative individual responses to social problems. The Student Center MOVE (Mobilizing Opportunities for Volunteer Experience) Office places individuals and groups with community agencies and organizes volunteer outings on a regular basis.

Counseling Center

The Counseling Center's professional counselors and psychologists assist in a confidential manner with academic, career, and personal concerns whenever students request counseling services. The Center's career counseling helps students examine and work toward resolving personal and interpersonal issues related to selecting a major or career. The Center's library provides a program of computer-assisted study skills instruction (CASSI-GT) and information about careers through reference books, videos, a computer-assisted decision-making program (SIGI PLUS), catalogs from other colleges and business and graduate schools, and a number of inventories and tests for determining occupational interests, abilities, and personality traits. More information is available on the website at: www.counseling.gatech.edu

Career Services

Career Services offers students a variety of services, from helping them choose a career to finding part-time and full-time employment. All information is readily accessible from the internet at www.career.gatech.edu. The office provides career counseling and testing; career planning and development information; seminars on resume writing, interviewing, business etiquette, networking, job search strategies, how to use the career library, etc.; videotaped mock interviews; cover letter and resume critiques; internship, part-time, and full-time job listings; literature and videos on more than 700 companies and government agencies; salary surveys; lists of recruiting companies and organizations; company contact information; graduate school information; and resume referral services.

Campus recruiting takes place each semester. Approximately 800 employers, representing a substantial number of the Fortune 500 corporations, recruit on campus annually. A resume book, consisting of graduating seniors' resumes, is available to interested employers.

Diversity Issues and Programs

Women's Resource Center

Women's programs enhance the performance and personal development of women at Georgia Tech by striving to create a more inclusive and supportive campus environment for women, and by promoting understanding among Georgia Tech's diverse community of women and men. Services and programs provide opportunities to involve female students in all phases of campus life.

Diversity Issues and Programs

The Office of Diversity Issues and Programs is responsible for fostering a vision of diversity appreciation, reflective of the Institute's strategic plan, which enables students from all backgrounds and cultures to thrive and succeed at Tech. The Office provides an institutionalized approach for meeting the co-curricular needs of underrepresented populations by coordinating and planning educational opportunities that enhance interaction and learning across groups. Through intentional educational programming and training, the Office assists the campus in understanding, appreciating, and celebrating Tech's rich cultural diversity. For additional information, contact the Office of the Dean of Students at (404) 894-6367.

Student Organizations

Georgia Tech has 280 chartered student organizations that offer a variety of activities for student involvement. These organizations are classified in the following categories: honor societies and governing boards, professional/departmental, service and educational, cultural/diversity, religious, and sport clubs.

Fraternities and Sororities

Georgia Tech's 39 social fraternities and sororities are coordinated by Student Affairs. The groups offer a variety of activities, opportunities, and services to the Georgia Tech community.

Student Publications and Radio

The student publications and radio communications boards oversee the budgeting and operation of the *Technique*, the official student newspaper; the *Blueprint*, the student yearbook; and other student publications, in addition to the operation of the student radio station, WREK 91.1 FM.

Other student publications include the *North Avenue Review,* an open forum magazine, and *Erato,* the student literary magazine.

Department of Housing

The Department of Housing oversees the assignment, operation, and maintenance of on-campus rooms for 6,300 single students and 300 married students. Amenities include local telephone service, cable TV, ethernet connectivity, learning centers, tutoring, laundry facilities, and fitness areas. A team of residence life staff members is available at all times. Additionally, housing for single graduate students and apartment complexes for single undergraduates are available. Residence hall programs provide counseling services and organized activities for residence hall and family housing residents. For further information, refer to the *Residential Living on the Georgia Tech Campus* brochure available at the Housing Office, or visit the website at: www.housing.gatech.edu

Student Health Center

The Primary Care Center's Hours
(Appointment required except in cases of emergency)

Monday-Friday 7:30 A.M.-6:30 P.M.	Full Staff
Sunday 2:00 P.M.-5:00 P.M.	Clinic with limited staff for urgent care

The Wellness Center's Hours
Monday-Friday 9:00 A.M.-5:00 P.M.

Health Center Telephone Number
(404) 894-2584

Website
www.gatech.edu/student.services/health services

The Student Health Center is an ambulatory health care clinic that provides medical care and health education for eligible students and spouses.

The Primary Care Center staff consists of general practice, family practice, and internal medicine physicians, as well as nurse practitioners, registered nurses, medical and radiological technologists, pharmacists, and health educators. Specialists in gynecology, orthopaedics, psychiatry, radiology, and dermatology, as well as a registered dietician, are available for consultation for a nominal fee. A women's health nurse practitioner is available for gynecological problems and preventive care, such as Pap smears. Contraceptive counseling and information on sexually transmitted disease are also available.

The Wellness Center is available to all Tech students and offers computer-assisted health and nutrition assessments, wellness seminars and events, an information resources center, and personal consultations.

Medical Entrance Form

Students will receive a Medical Entrance Form with their letter of acceptance. All students, graduate and undergraduate, should complete the form and mail it to the Student Health Center before registration. In addition to the Medical Entrance Form, students must provide evidence of updated immunization certificate and tuberculosis screening. Completed forms must be mailed to:

Student Health Services
Georgia Institute of Technology
275 Fifth Street N.W.
Atlanta, Georgia 30332-0470
Attention: Medical Records Dept.

Tuberculosis (TB) Screening

All matriculating students must provide documentation of TB screening prior to registration. **Failure to do so will prevent registration.** For information on required documentation, consult your admissions packet.

Immunizations

All Georgia Tech students must provide documentation of immunization for measles, mumps, and rubella (MMR) prior to attending class. Proof of immunization or immunity must be documented on a Certificate of Immunization by a medical practitioner. Students born before December 31, 1956, need only provide documentation of rubella immunity.

Eligibility for Treatment

Students enrolled in classes, co-op students, spouses of students enrolled in classes or the co-op program (if both the student and spouse have paid their health fees), cross-enrolled students who have paid their health fee for the semester, and continuing students with a current student I.D. are eligible for treatment provided the health fee has been paid.

Terms of Eligibility

Once the health fee has been paid, students/spouses are eligible for services from the date paid through the end of break week for each semester; new students are eligible for services during the break week that precedes the semester they are entering if they can present proof that the fee was paid.

Cost

A semester health fee is automatically assessed to students taking six hours or more. All others must pay the health fee at the health center or present the health center with proof that the health fee has been paid. A $10 late penalty will be assessed if the health fee is paid after the second week of each semester.

Special Health Considerations

It is the responsibility of all students to notify the Health Service, the Department of Health and Performance Sciences, and the Office of Disabled Services of any disability that would make participation in swimming, competitive sports, and aerobic training hazardous to their well-being. Any student requesting special consideration because of mental or physical disability should have his or her physician write an explanatory letter, giving full details of the disability and consequent limitations on physical activity, to the medical director of the Student Health Center. This letter must accompany the Medical Entrance Form.

Health and Accident Insurance

Supplemental insurance to cover major illnesses and surgeries, specialist consultations, and diagnostic procedures (not available at the Student Health Center) should be purchased by all students who are not included in their parents' or spouses' medical insurance plans. Generally, private hospitals will not admit patients who do not have hospitalization insurance.

International Student Services & Programs (ISSP)

The ISSP Department provides services and programs for more than 1,300 international students and more than 280 international exchange visitors from approximately 100 countries. These students and exchange visitors receive assistance in maintaining status with the U.S. immigration and naturalization service and in adjusting to Georgia Tech and U.S. culture. In return, many of the students and exchange visitors work with the ISSP staff to develop programs promoting intercultural understanding. For more information, call (404) 894-7475.

Study Abroad

The Study Abroad Office (SAO) serves as a centralized point for information regarding Georgia Tech, the University System, and other institutions' study abroad and exchange programs. In order to prepare students for the "global marketplace" of the twenty-first century, Georgia Tech offers numerous, diverse programs to study for a semester or longer in another country and receive Tech credit for the courses completed. Tech has exchange programs in countries across the globe that allow students to pay Tech tuition, continue receiving financial aid, and transfer credit toward a Tech degree. SAO will advise students about everything from program options and financial aid procedures to credit transfer, visas, and international health insurance. Anyone who wishes to be in the vanguard rather than the rear guard of a world where more and more employers value international experience should consider studying abroad. For more information, contact the Study Abroad Office in Suite 115A of the Hightower Building.

FASET Orientation (new student orientation)

The student/parent orientation program informs new students and their parents of academic programs and requirements, in addition to familiarizing them with Tech traditions and the activities and services available on campus. For more information, call (404) 894-6897.

OMED: Educational Services

OMED is an academic service organization that seeks to assist Georgia Tech in its development of the complete learner who is a gifted African American, Native American, Latino, or Hispanic. This complete development is intended to ensure that these students become inspired, high-performing problem solvers. When they graduate or leave Tech, their choice set is optimal and they, as well as their families, will have had a positive and gratifying experience.

Student Athletic Complex

The Fuller E. Callaway III Student Athletic Complex (SAC) houses all campus recreation facilities as well as the Campus Recreation Department. Facilities include: a 50-meter bubble-covered pool, and the Olympic Aquatic Center with diving well; six multipurpose courts for basketball, volleyball, and badminton; eight indoor racquetball and two squash courts; a cardio-theater with aerobic conditioning equipment (stairmaster, treadmills, Concept II rowing machines); and a weight room with free weights and machines. SAC is open daily with the exception of home football games and holidays.

Robert Ferst Center for the Arts

The Robert Ferst Center for the Arts serves as a showcase for the presentation of concerts, recitals, lectures, dance, and theater.

Since opening its doors in 1992, the Center has provided a once-in-a-lifetime opportunity for the students of Georgia Tech to experience the finest entertainers in the world at truly affordable prices. Each year the Center for the Arts hosts memorable performances and events such as the 1992 Vice Presidential debate; the former Secretaries of Defense Roundtable Discussion; violinist Itzhak Perlman; renowned mime Marcel Marceau; comedic magicians Penn & Teller; the Atlanta Ballet; and the New York Opera.

The Robert Ferst Center for the Arts not only houses the theater, but also the Richards and Westbrook galleries, located in the foyer of the Center. The galleries feature displays from local and traveling exhibits of fine arts and high technology. The James E. Dull Theatre, which is home to DramaTech, is also located within the Center.

The Center for the Arts is committed to exploring the links between the arts and technology and serves as a prominent example of Georgia Tech's dedication to excellence and outstanding performance—both on campus and in the metro Atlanta community.

DramaTech

DramaTech, Atlanta's oldest theater company, produces at least four plays a year, offering a unique aspect of Georgia Tech life. DramaTech attempts to uncover and nourish the creative talents of Tech's future engineers, managers, architects, scientists, and leaders, talents that might otherwise never develop in the world of calculators, computers, designs, and formulas.

DramaTech is unique among area college theaters in that it is student run. Although Georgia

Tech has no theater department, the director is part of the faculty of the School of Literature, Communication, and Culture. Participation in the theater is open to all students, faculty, staff, and Tech alumni. Students may earn credit for participation in DramaTech through the School of Literature, Communication, and Culture.

For more information, call DramaTech at (404) 894-3481.

Student Center

The Fred B. Wenn Student Center is located in the heart of the Georgia Tech campus and provides many vital services to Tech students. Governed and operated by students, the Student Center Program Council consists of student-run planning committees that organize and coordinate campus-wide activities and events. The Student Center houses the post office, bowling and billiards facilities, video games, a crafts center, the MOVE community service office, a music listening room, a newly renovated ballroom, several smaller meeting rooms, a credit union, a Macintosh lab, lounge and study areas, and several dining options. Vans, cellular phones, and audio/visual equipment are available for use by student organizations through the Student Center Administrative Office. Also located in the Student Center is the Center for the Arts Box Office, offering student discounted tickets to a variety of entertainment events.

The hours of operation for many of the Student Center services vary; however, the Student Center building is open 24 hours a day, 7 days a week, providing students with a place to meet and study.

Student Government

The Georgia Tech Undergraduate and Graduate Student Government Associations (SGA) enable students to maintain responsible and respected self-government and official institutional involvement in academic and nonacademic affairs. For more information, contact the SGA offices in the Student Services Building at (404) 894-2814.

Assistance for Persons with Disabilities

The Access Disabled Assistance Program for Tech Students (ADAPTS) provides accessible programs, services, activities, and reasonable accommodations for any student, employee, or visitor with a disability as defined by section 504 of the Rehabilitation Act of 1973, as amended, and by the Americans with Disabilities Act of 1990. Services are available to ensure that individuals with disabilities have an equal opportunity to pursue education, employment, or other campus programs, activities, or services.

ADAPTS offers self-identified students with permanent or temporary disabilities assistance with registration, academic advisement, accessibility, transportation, parking, housing, counseling, tutoring, notetaking, recorded textbooks, advocacy, test proctoring, referral services, and other needs. ADAPTS sponsors a student advisory club and promotes disability awareness programs for departmental faculty and staff, as well as student organizations. Interpreting services are available for deaf students, and assistive listening devices are available for loan to students who are hard of hearing.

Students and prospective students who wish to learn more about ADAPTS and accommodations for students with disabilities should contact ADAPTS, Smithgall Student Services Building, Georgia Institute of Technology, Atlanta, Georgia, 30332-0285, or call (404) 894-2564 (voice) or (404) 894-1664 (TDD) or visit the website at: www.adapts.@gatech.edu. Faculty, staff, and visitors should contact Disability Services in the Office of Human Resources at (404) 894-3344 (voice) or (404) 894-9411 (TDD).

Academic Accommodations for Students with Disabilities

Reasonable accommodations are provided to self-identified students with disabilities who meet the academic and technical standards requisite to admission or participation in the program of study. Incoming students with apparent course work deficiences due to a disability should contact the coordinator for Students with Disabilities at (404) 894-2564.

Consideration may be given to the substitution or modification of certain course requirements—within the limitations imposed by the accreditation criteria for the degree program in which the student is enrolled—and to the extent that such substitutions or modifications of the course or curriculum do not have a net effect of detracting from the quality of the educational experience implied by the course or curriculum designation. Such substitutions or modifications must be approved by the school director, department head, or college dean, and the Undergraduate Curriculum Committee and/or the Graduate Committee.

Nontraditional Student Services

For the Nontraditional Student (undergraduates over age 25, graduate students over age 30, and financially independent students whose lifestyles vary significantly from those of younger students), the Office of the Dean of Students recognizes the importance of each individual student, encourages personal growth, and supports academic pursuits through advocacy and referral services. For assistance, contact the assistant dean of Students at (404) 894-2564.

Notification of Student Rights under FERPA

The Family Educational Rights and Privacy Act (FERPA) affords students certain rights with respect to their education records. They are:

1. The right to inspect and review the student's education records within 45 days of the day that the Institute receives the request for access.

Students should submit to the registrar written requests that identify the record(s) they wish to inspect. The registrar will make arrangements for access and notify the student of the time and place where the records may be inspected.

2. The right to request amendment of the student's education records that the student believes are inaccurate or misleading.

Students may ask the Institute to amend a record that they believe is inaccurate or misleading. They should write the Office of the Registrar, clearly identifying the part of the record they want changed, and specify why it is inaccurate or misleading.

If the Institute decides not to amend the record as requested by the student, the Institute will notify the student of the decision and advise the student of his or her right to a hearing regarding the request for amendment. Additional information regarding the hearing procedures will be provided to the student when he or she is notified of the right to a hearing.

3. The right to consent to disclosures of personally identifiable information contained in the student's education records, except to the extent that FERPA authorizes disclosure without consent.

One exception that permits disclosure without consent is disclosure to school officials with legitimate educational interests. A school official is a person employed by the Institute in an administrative, supervisory, academic, research, or support staff position (including law enforcement unit personnel and health staff); a person or company with whom the Institute has contracted (such as an attorney, auditor, or collection agent); a person serving on the Board of Trustees; or a student serving on an official committee, such as a disciplinary or grievance committee, or assisting another school official in performing his or her tasks.

A school official has a legitimate educational interest if he or she needs to review an education record in order to fulfill his or her professional responsibility.

4. The right to file a complaint with the U.S. Department of Education concerning alleged failures by the Georgia Institute of Technology to comply with the requirements of FERPA. FERPA is administered by:

Family Policy Compliance Office
U.S. Department of Education
600 Independence Avenue, S.W.
Washington, D.C. 20202-4605

The address for the registrar is:

Office of the Registrar
Georgia Institute of Technology
Atlanta, GA 30332-0315

Directory Information

"Directory Information" is information not generally considered harmful or an invasion of privacy if disclosed. The Georgia Institute of Technology considers the following information to be Directory Information:

Name, address, and telephone listing
Level (graduate or undergraduate)
Field of study
Dates of attendance
Degrees and date awarded

Directory Information cannot include student identification numbers or social security numbers.

Students who wish to discuss the prohibition of release of Directory Information should contact the Registrar's Office for procedural information.

Policy on Sexual Harassment

Sexual harassment of employees or students in the University System is prohibited and shall subject the offender to dismissal or other sanctions after compliance with procedural due process requirements. Unwelcome sexual advances, requests for sexual favors, and other conduct of a sexual nature can constitute sexual harassment. For more information, contact the dean of Students at (404) 894-2560 or the director of Employee Relations at (404) 894-9412.

Student Alcohol Policy

Georgia Tech complies with all federal, state, and local laws and policies, including the policies of the Board of Regents of the University System of Georgia, on the abuse of alcohol and other drugs by its students. The legal drinking age in Georgia is 21. Each member of the Tech community should be involved in the implementation of the Student Alcohol Policy. This policy is distributed in student mailboxes annually.

In accordance with federal and state laws and because of the potential detriment to the health, well being, and success of students, all students are prohibited from engaging in the unlawful use or abuse, possession, manufacture, distribution, dispensation, and sale of alcoholic beverages, controlled substances (including marijuana), and other drugs.

Intellectual Property Policy

The Institute's Intellectual Property Policy, concerning inventions, copyright, and computer software, applies to students as well as to faculty and staff. Adherence thereto is a condition of continued enrollment at the Institute.

Academic Honor Code

A student initiative, the Academic Honor Code became official Institute policy in 1996. Students are required to sign an honor agreement acknowledging their awareness of the Code. All students are strongly encouraged to understand each instructor's Academic Honor expectations. The objective of the Honor Code is to level the academic playing field for all students while strengthening the level of academic integrity and trust within the Georgia Tech community.

Parking Policy

Freshmen entering the fall semester are not allowed to register a vehicle for a parking permit during their first semester at Tech. These students can apply for a parking permit during spring and summer terms. Assignments will be made on a space-available basis.

For further information, contact the Georgia Tech Parking Office at (404) 894-4611.

Required Student Computer Ownership

In an effort to foster equal access to computers and to make the most of the teaching and learning technology available at Georgia Tech, all freshmen and other students entering Georgia Tech under this or subsequent catalogs are required to own or lease a computer.

Each spring, students accepted for the following summer and fall semesters are notified of the minimum platform and software requirements as well as purchasing and financing options.

Because computer ownership is mandatory, an average cost for the minimum platform and software required will be included in computing each new student's cost of education for the purpose of determining their eligibility for all forms of student aid.

Special Support Facilities

Library and Information Center

The Georgia Tech Library and Information Center houses one of the nation's largest collections of scientific and technical literature. Resources include more than 3 million volumes, more than 600,000 government documents, more than 3,000 video tapes, a complete collection of U.S. patents, and approximately 2 million technical reports. The library receives more than 14,000 current periodicals.

Georgia Tech faculty, students, and staff have access to more than 200 online databases containing citations, abstracts, newspapers, indexes to journals and conference proceedings, and the full text of many periodicals. These databases, as well as the Library's catalog, are accessed through GTEL® (the Georgia Tech Electronic Library) and Galileo, a statewide database service. Gateways to a variety of information resources available on the internet are provided through GTEL®.

Students, faculty, and staff may use libraries at Emory University, Georgia State University, the University of Georgia, and other local schools via a Georgia Tech ID card.

Copiers are available on several floors of the Library. Students may use facilities for group or individual study. The Library's information consultants provide training classes for all students in the use of GTEL®, Galileo, and the internet. Consultants also are available for advice about individual information needs.

Information Technology and Computing Facilities

The Office of Information Technology (OIT) provides communications and computing technology leadership and support to all Georgia Tech students, faculty, staff, and researchers. Its mission is to serve the campus community in several critical areas, including customer service for computing, communications, the Student Computer Ownership Policy, and the growing area of educational technologies.

OIT issues computer accounts to all students, faculty, and staff for Institute-related activities such as internet access; electronic mail; electronic publishing; information and database storage and retrieval; homework; and class assignments.

The campus network connects more than 160 buildings, including more than 30 residence halls and more than 35 sorority and fraternity houses, via fiber optic cables to the OIT central computing facilities, located in the Rich Building. Network connections are available in every residence hall (one for each bed), and all appropriate administrative, academic, and research work-stations; classrooms; campus ministries; and most fraternity and sorority houses. The Institute's Network and Computer Usage Policy governs acceptable use of these facilities.

OIT also supports the campus cable television network in association with the Department of Housing. This service is also available to the academic and research communities.

In addition, OIT is playing a major role in the development of Internet2, serving as the home for the Georgia gigaPoP, the largest aggregation point in the Southeast for universities to connect to the emerging national high-speed networking fabric.

In 1998, OIT established a campus office to coordinate all Year 2000 initiatives along with an active response team to address these issues, permitting Tech to operate its information systems effectively into the next century.

OIT consists of six directorates: Customer Support; Educational Technologies; Enterprise Information Systems; Operations and Engineering; Planning and Programs; and Resource Management.

Customer Support provides support to campus users in a variety of computer-related areas. Specifically, the Customer Support Center provides support for microcomputer and workstation software applications; account administration for central computing resources; support for Macintosh, DOS, Windows, and UNIX operating systems; electronic mail; and workstation utilities.

The Customer Service Center can be reached via e-mail at support@oit.gatech.edu, by phone at (404) 894-7173, or through the Web at: www.oit.gatech.edu/cs/csc/

Educational Technologies serves as the technology advocate for the academic faculty and also provides support services to faculty members who wish to experiment with alternative classroom instructional methods.

Enterprise Information Systems is responsible for designing, implementing, and supporting Tech's administrative information systems; developing and maintaining the Institute's data repository; and providing information management support to all departments.

Operations and Engineering is responsible for the design, development, operation, management, and maintenance of the core campus servers and systems, as well as the data, voice, and video communications networks for the Georgia Tech community.

Planning and Programs is responsible for strategic planning, program management support, information security, and policy development.

Resource Management provides centralized management of OIT's budgetary, purchasing, facilities management, and human resource functions, and Georgia Tech's electronic data processing. Other areas include Public Relations and Printing and Copying Services (PSC).

The Office of Information Technology home page is located at: www.oit.gatech.edu

Georgia Tech Research Institute

The Georgia Tech Research Institute (GTRI) is a client-oriented, not-for-profit research organization that is an integral unit of the Georgia Institute of Technology. GTRI conducts basic and applied research in engineering, science, and economic development for a diversity of sponsors including federal, state, and local governmental agencies, industrial firms, and private organizations.

Chartered by the Georgia legislature in 1919 and activated in 1934, the GTRI mission is to plan and conduct focused programs of innovative research and development, education, and economic development that advance the global competitiveness and security of the state of Georgia, the region, and the nation.

GTRI works closely with Tech's academic colleges, interdisciplinary centers, and the Economic Development Institute in areas of research, education, and service. GTRI's vision is to be the most respected university-based applied research institute in the nation.

The staff is composed of engineers, scientists, support staff, and students (undergraduate and graduate). Employees work in nine laboratories and several support groups housed on campus, the Cobb County Research Facility; Huntsville, Alabama; and Arlington, Virginia. Field offices are maintained in Arlington, Virginia; Dayton, Ohio; Ft. Walton Beach, Florida; Ft. Monmouth, New Jersey; Huntsville, Alabama; and Warner Robins, Georgia.

Research programs at GTRI include acoustics, aerospace sciences and technology, communications and information technology, electromagnetic environmental effects, electronic defense, environmental science and technology, food processing technology, human factors, infrared/electro-optics, law enforcement technology, learning technology, manufacturing technology, materials science, microelectronics and applications, modeling and simulation, occupational health and safety, optoelectronics/photonics, radar, secure information systems, simulator testbeds, test and evaluation, and transportation.

One of GTRI's principal missions is to support economic and technological development in Georgia. GTRI promotes economic growth in the state and the Southeast through mutual programs with the Economic Development Institute. GTRI operates strong technology transfer programs and offers continuing education courses. It is the home of the state's Agricultural Research Technology Program, which conducts research and technology transfer for the poultry industry, one of Georgia's leading employers.

For additional information, contact the Office of the Vice President and Director, GTRI, Centennial Research Building, Atlanta, Georgia 30332-0801, or call (404) 894-3411.

Advanced Technology Development Center

The Advanced Technology Development Center (ATDC) is the oldest and most experienced university-affiliated technology development center in the country. It was formed in 1980 by the governor and General Assembly to increase the technology business base in Georgia. ATDC fulfills this mission by assisting in the formation and growth of advanced technology start-up companies, supporting technology commercialization, and attracting technology companies to the state. In 1996, ATDC was named "Incubator of the Year" by the National Business Incubation Association.

ATDC is headquartered in the 83,000 sq. ft. Technology Business Center on the Tech campus. ATDC also has facilities at Warner Robins and at the Georgia Center for Advanced Telecommunications Technology location. At these locations, early-stage companies enjoy a strong entrepreneurial working environment, access to professional business consulting, contact with university research faculty, and modern office and laboratory facilities. The ATDC also provides companies with access to facilities, personnel, and students in the University System.

ATDC's increasingly proactive efforts to facilitate commercialization of university technology, as exemplified by the Faculty Research Commercialization Program, help bring high-tech concepts from the university research laboratory to commercial product realization.

ATDC assists in economic development efforts in key technological areas around Georgia. ATDC/Warner Robins is working to encourage the development of new defense and aerospace technology firms. ATDC provides assistance to entrepreneurs throughout the state in cooperation with its parent organization, the Economic Development Institute.

Department of Distance Learning, Continuing Education, and Outreach

Georgia Tech makes the educational resources of its academic and research units accessible to working professionals throughout the state and the nation through its Department of Distance Learning, Continuing Education, and Outreach. Tech is committed to offering the best quality professional development programs available anywhere in the world. Short courses, workshops, conferences, and on-site programs help keep professionals abreast of the latest developments and innovations in their professional fields, while distance learning programs provide access to Tech's vast educational resources from the home or job site.

Distance Learning. Graduate-level courses in the fields of engineering listed below are available throughout the state and the nation by videotape. Selected courses are available at some locations by videoconferencing and satellite. A Master of Science degree also can be earned in these fields.

- Electrical engineering
- Environmental engineering
- Health physics/radiological engineering
- Industrial engineering
- Mechanical engineering

Students at remote sites receive by mail class handouts and videotapes of campus class sessions, and communicate with the instructor by telephone, computer, fax, and/or e-mail. Qualified candidates are enrolled as regular part-time graduate students. For a semester calendar, call (404) 894-3379, fax (404) 894-8924, write to the Center for Distance Learning, Georgia Institute of Technology, Atlanta, Georgia 30332-0385, or e-mail: VIBS@conted.gatech.edu.

Continuing Education. Short courses varying in length from one to five days are offered throughout the year to assist professionals with acquiring knowledge of different fields and new technologies. Courses are offered on various topics in engineering, architecture, science, management, and computing, as well as the Georgia Tech Research Institute and the Economic Development Institute. For a semester calendar, call (404) 894-2547, fax (404) 894-7398, or write to Continuing Education, Georgia Institute of Technology, Atlanta, Georgia 30332-0385 or e-mail: conted@gatech.edu or visit the homepage on the internet at: www.conted.gatech.edu.

Language Institute. The Language Institute offers classes to international students and business and professional people. An intensive English program provides six levels of instruction in English as a second language each semester to participants from around the world. The program facilitates the assimilation of international students into campus life in the United States through orientation and assistance in the admissions process to American colleges and universities. The Language Institute also offers courses for business and professional people in English and other languages. For descriptive brochures, call (404) 894-2425, fax (404) 894-8755, or write to Director, Language Institute, Georgia Institute of Technology, Atlanta, Georgia 30332-0374, USA, or e-mail: charles.windish@conted.gatech.edu.

Oak Ridge Associated Universities

Georgia Institute of Technology has been a sponsoring institution of Oak Ridge Associated Universities (ORAU) since 1946. ORAU is a private, not-for-profit consortium of 65 colleges and universities and a management and operating contractor for the U.S. Department of Energy (DOE) with principal offices located in Oak Ridge, Tennessee. ORAU provides and develops capabilities critical to the nation's technology infrastructure, particularly in energy, education, health, and the environment. ORAU works with and for its member institutions to help faculty and students gain access to federal research facilities; to keep members informed about opportunities for fellowship, scholarship, and research appointments; and to organize research alliances among members in areas where their collective strengths can be focused on issues of national importance.

ORAU manages the Oak Ridge Institute for Science and Education (ORISE) for DOE. ORISE is responsible for national and international programs in science and engineering education, training and management systems, energy and environment systems, and medical sciences. ORISE's competitive programs bring students at all levels, K-12 through postgraduate, and university faculty members into federal and private laboratories.

ORAU's office for University, Industry, and Government Alliances (UIGA) seeks out opportunities for collaborative alliances among its member universities, private industry, and federal laboratories. Current alliances include the Southern Association for High Energy Physics (SAHEP) and the Center for Bio-electromagnetic Interaction Research (CBEIR). Other UIGA activities include the sponsorship of conferences and workshops, the Visiting Scholars program, and the Junior Faculty Enhancement Awards.

More information is available from Georgia Tech's representative on the ORAU Council, Gordon Wishon, or by writing to University Programs Division, P.O. Box 117, Oak Ridge, Tennessee 37831-0117.

Skidaway Institute of Oceanography

Located on Skidaway Island near Savannah, the Skidaway Institute provides a complex of coastal- and marine-related educational and research opportunities. Members of the Tech faculty and their students can either participate in established research activities or initiate research compatible with the facility's purpose.

The Institute maintains small boats and the R/V *Blue Fin*, a 72-foot vessel for research at distances up to 100 miles offshore. Areas of research expertise at the Institute include chemical oceanography, physical oceanography, biological oceanography, and marine geology.

Georgia Tech Lorraine

Located in France in the Technopole Metz 2000 technology park in the Lorraine region, Georgia Tech Lorraine (GTL) serves as the Georgia Institute of Technology platform in Europe. GTL conducts graduate education in engineering, has ongoing programs of basic and applied research, and offers continuing education courses.

At GTL, students can pursue regular academic programs of Georgia Tech while immersed in the rich culture of Europe. Instructional programs leading to master's degrees and Ph.D.s in electrical and computer engineering and in mechanical engineering are available to graduate students throughout the year. In addition, double-degree programs that lead to both a Georgia Tech degree and a diploma from a European university have been developed. Undergraduate summer programs in engineering, management, and social sciences are offered to any qualified student.

All instruction at GTL is in English. French language courses are also available to enhance students' experience as well as to enable students to participate in a double-degree program.

GTL operates in a 50,000-square-foot building that houses classrooms, academic and research laboratories, student lounges, conference rooms, and a library, along with faculty and staff offices. Student housing is available for all GTL students. Many student-oriented facilities are available close to the GTL campus, along with the diverse cultural and entertainment resources of the city of Metz.

Joint CNRS Research Laboratory

As the result of a strategic alliance between the Georgia Institute of Technology and the French Centre National de la Recherche Scientifique (CNRS), a joint GIT/CNRS research laboratory was established in 1998 at GTL. The laboratory, the Centre GTL-CNRS Telecom, conducts a unique transatlantic collaborative program of research in telecommunications and related areas. Research faculty and graduate students from Georgia Tech, French universities, and other CNRS laboratories work on joint research projects sponsored by industry and by local and national governments. Initial research programs center on opto-electronic techniques for signal encryption and secure transmission, signal coding for wireless communications and for data transmission in hyperlans, and soliton transmission and wavelength division multiplexing and signal routing in optical fiber transmission links. The program will expand to include a diversity of research in telecommunications and in the area of integrated sensors and sensor networks.

For more information, contact GTL-CNRS Telecom at +33 387 20 3939 or send e-mail to: gtl-cnrs-telecom@georgiatech-metz.fr.

Office of International Education (OIE), University System of Georgia

The University System of Georgia is committed to achieving world-class status by empowering its institutions to enable their faculty, students, and staff to participate effectively in a global society. Strategic alliances, partnerships, and other collaborative initiatives will provide the international perspective and cross-cultural competence required for Georgians to lead effectively in a global society. To accomplish these goals, the System Council for International Education (SCIE), which functions as a part of the Office of International Education, was appointed in 1995. With representatives from the business community, leadership from the System institutions, and international education efforts, the Council's role is to develop a vision and strategic plan for implementing the goals identified in the International Policy of the Board of Regents.

Interdisciplinary Programs

The Office of Interdisciplinary Programs (OIP) coordinates interdisciplinary research centers at Georgia Tech. The office currently provides administrative coordination for 20 units. The five programs in bioengineering and the biosciences are coordinated by the Institute for Bioengineering and Biosciences. Other centers report directly to OIP. Each unit is listed below and a contact and telephone number supplied. For more information on each center, call the number provided or call the Office of Interdisciplinary Programs at (404) 894-2375.

Air Resources and Engineering Center
Contact: Shaw C. Liu, (404) 894-1758

Broadband Telecommunications Center
Contacts: John Limb, (404) 894-9106
Daniel Howard, (404) 894-3541

Center for Human Movement Studies
Contact: Robert Gregor, (404) 894-1028

Center for Optical Science and Engineering
Contact: William T. Rhodes, (404) 894-2929

Center for Sustainable Technology
Contact: Carol Carmichael, (404) 894-7895

Environmental Resources Center
Contact: Bernd Kahn, (404) 894-3776

Georgia Center for Advanced Telecommunications Technology (GCATT)
Contact: Michael Cummins, (404) 894-9211

Georgia Transportation Institute
Contact: Glenn Rix, (404) 894-2292

Georgia Water Resources Institute
Contact: Aris Georgakakos, (404) 894-2240

Institute for Bioengineering and Biosciences
Contact: Robert Nerem, (404) 894-2768

Bioengineering Center
Contact: Ajit Yoganathan, (404) 894-2849

Biomedical Interactive Technology Center
Contact: Michael Burrow, (404) 894-7034

Biosciences Center
Contact: Sheldon May, (404) 894-4052

Emory-Georgia Tech Biomedical Technology Research Center
Contact: Ajit Yoganathan, (404) 894-2849

GIT/MCG Biomedical Research and Education Program
Contact: Loren Williams, (404) 894-9752

Interactive Media Technology Center
Contacts: Andrew Quay, (404) 894-4195
Ed Price, (404) 894-4195

Manufacturing Research Center
Contact: Steven Danyluk, (404) 894-9100

Microelectronics Research Center
Contact: James D. Meindl, (404) 894-5028

Polymer Education and Research Center
Contact: A.S. Abhiraman, (404) 894-2874

Specialty Separations Center
Contacts: Charles A. Eckert, (404) 894-7070
Amyn Teja, (404) 894-3098

The schools of the Institute are authorized to offer graduate degrees, develop and administer their own individual programs, and work closely with one another to provide special study and research opportunities for students who wish to pursue a degree with a wider perspective than that presented by a single discipline. Cooperation between academic units and various research centers and the development of informal programs based on areas of faculty interest have resulted in the establishment of interdisciplinary programs in a number of areas, such as computer integrated manufacturing systems and microelectronics. The College of Engineering lists a large number of multidisciplinary programs on page 122 of this catalog. The College of Computing offers an interdisciplinary certificate in cognitive science, see page 91. The role of the DuPree College of Management in multidisciplinary programs is discussed on page 105. Multidisciplinary programs in the College of Sciences are discussed on page 275.

Affiliated Organizations

The Georgia Tech Athletic Association

Intercollegiate sports are administered by this non-profit corporation through a board of trustees consisting of seven faculty members, three alumni, and three students, with the president of Georgia Tech serving as chair. The Athletic Association is committed to the development, preparation, support, and graduation of student-athletes through its Total Person Program and Academic Center. The Association provides and maintains facilities that allow the participation and enjoyment of a variety of sporting events by members of the Georgia Tech and Atlanta communities. Intercollegiate sports include football, basketball, cross country, indoor/outdoor track, golf, tennis, baseball, volleyball, swimming, and softball. The Athletic Association has made a commitment to excellence and to complement the mission of the Institute.

The Georgia Tech Alumni Association

The Georgia Tech Alumni Association was chartered in 1908 as a nonprofit organization. Its mission is (1) to promote active alumni participation at Georgia Tech events; (2) to promote alumni volunteer support for Tech through Roll Call, special projects, capital campaigns, and other fund-raising activities; (3) to promote the academic and research achievements of the Institute; (4) to act as liaison between the alumni and the administration; and (5) to manage the resources of the Association in a cost-effective manner.

The Georgia Tech Alumni Association has won national and local recognition for its outstanding programs and achievements. It accomplishes its mission through the publication of a quarterly magazine and newspaper, an extensive network of clubs, and special events such as homecoming, reunions, and an annual career conference. The Association also manages the annual fund and Roll Call, and maintains statistical records and files necessary for communicating with Georgia Tech's many alumni and friends.

The Alumni Association offices are located in the L.W. "Chip" Robert Jr. Alumni/Faculty House at 190 North Avenue; (404) 894-2391, or 1-800-GTALUMS. Fax number: (404) 894-5113. Web address: **www.alumni.gatech.edu**

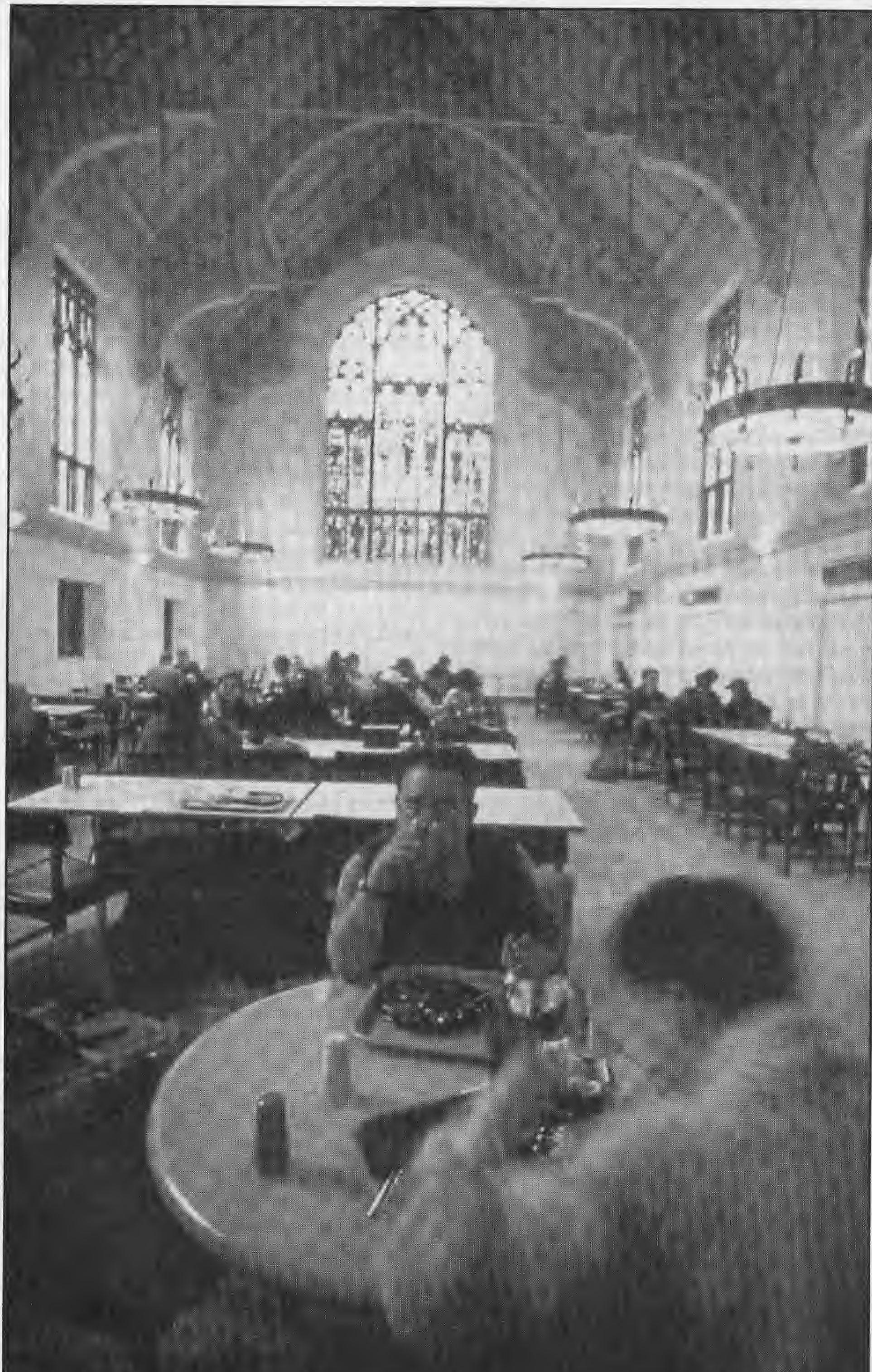
Georgia Tech Foundation Inc.

The Georgia Tech Foundation Inc. is a not-for-profit, tax-exempt corporation that receives, administers, and invests virtually all private contributions made in support of the academic programs of the Georgia Institute of Technology. The Foundation maintains its support of the Institute through the regular and emeritus members of its board of trustees, who are distinguished by their expertise in financial management and investments and by their devotion to Georgia Tech.

Endowment funds maintained by the Foundation furnish student scholarships and fellowships, faculty assistance, and general support to the academic divisions of the Institute. In addition, gifts and income from undesignated endowments provide unrestricted funds that help meet the most pressing needs of the Institute.

The Georgia Tech Research Corporation

Founded in 1937, the Georgia Tech Research Corporation (GTRC) is a state-chartered, not-for-profit corporation serving Georgia Tech as a University System of Georgia-approved cooperative organization. By charter, GTRC "...shall be operated exclusively for scientific, literary, and educational purposes...conduct laboratories, engage in scientific research, and distribute and disseminate information resulting from research..." GTRC is an IRS section 501(c)(3) not-for-profit organization and serves as the contracting agency for all of the sponsored research activities at Georgia Tech. It also licenses all intellectual property (patents, software, trade secrets, etc.) created at Georgia Tech. Additionally, GTRC assists Georgia Tech in obtaining quality research space, enters into long-term leases for specialized research equipment, and conducts other research support programs as requested by the Institute. All funds collected by GTRC are used to support various Georgia Tech research programs requested by the Institute and as approved by the 12-member Board of Trustees. GTRC is located on campus in the Centennial Research Building.



INFORMATION FOR UNDERGRADUATE STUDENTS

Degrees

Georgia Tech at present offers curricula leading to the following undergraduate degrees:

COLLEGE OF ARCHITECTURE
Bachelor of Science
Bachelor of Science in Building Construction
Bachelor of Science in Industrial Design

COLLEGE OF COMPUTING
Bachelor of Science
Bachelor of Science in Computer Science

COLLEGE OF ENGINEERING
Bachelor of Science
Bachelor of Science in Aerospace Engineering
Bachelor of Science in Chemical Engineering
Bachelor of Science in Civil Engineering
Bachelor of Science in Computer Engineering
Bachelor of Science in Electrical Engineering
Bachelor of Science in Industrial Engineering
Bachelor of Science in Materials Science and Engineering
Bachelor of Science in Mechanical Engineering
Bachelor of Science in Nuclear and Radiological Engineering
Bachelor of Science in Polymer and Textile Chemistry
Bachelor of Science in Textile Enterprise Management
Bachelor of Science in Textile and Fiber Engineering

DUPREE COLLEGE OF MANAGEMENT
Bachelor of Science
Bachelor of Science in Management

IVAN ALLEN COLLEGE
Bachelor of Science
Bachelor of Science in Economics
Bachelor of Science in History, Technology, and Society
Bachelor of Science in International Affairs
Bachelor of Science in Public Policy
Bachelor of Science in Science, Technology, and Culture

COLLEGE OF SCIENCES
Bachelor of Science
Bachelor of Science in Applied Mathematics
Bachelor of Science in Applied Physics
Bachelor of Science in Applied Psychology
Bachelor of Science in Biology
Bachelor of Science in Chemistry
Bachelor of Science in Discrete Mathematics
Bachelor of Science in Earth and Atmospheric Sciences
Bachelor of Science in Physics

Requirements for each degree are listed in "Curricula and Courses of Instruction" under the school responsible for the program. Students should select a degree program as early as possible, preferably with their request for admission, but may postpone the decision and enter as undecided majors. Students who have selected a degree program receive academic advisement from the appropriate school; undecided students are advised through the respective offices of the deans of the six colleges.

Undergraduates who have completed the required number of work terms through the Cooperative Division receive the degree with the designation "Cooperative Plan," or if they have met certain language and international work experience requirements, the designation "International Cooperative Plan" is awarded.

Special Programs

The Cooperative Plan

Since 1912, Tech has offered two plans of study —the standard four-year plan and a five-year cooperative plan for students who wish to combine practical experience with technical theory.

Approximately 3,500 cooperative students, selected from applicants on the basis of high scholarship, work with more than 600 employers throughout the country (as well as a few international assignments), while they complete academic degree programs.

The Cooperative Division offers programs for majors in aerospace, chemical, civil, computer, electrical, industrial, materials, mechanical, nuclear and radiological, and textile and fiber engineering (including textiles and polymer and textile chemistry), and in biology, chemistry, engineering science and mechanics, computer science, earth and atmospheric science, mathematics, physics, management, economics, international affairs, industrial design, and society, technology, and culture. The academic curricula are identical to those offered regular four-year students. Co-ops also remain on the school rolls while on work periods by registering for the appropriate co-op course.

The cooperative program offers the student practical experience and insight into human relations, as well as financial assistance. The work experience co-op students receive is a valuable asset to graduates starting out in their chosen professions. Neither college laboratory experience nor employment during vacations can take the place of organized co-op training. The plan provides, to a substantial degree, the experience most companies require of their employees before promoting them to positions of responsibility. Work experience may also assist students undecided about their future plans in determining early in their college careers whether they wish to continue in a particular field.

Moreover, daily contact with diverse groups among their fellow employees offers students practical insight into sociology, psychology, economics, and ethics that no textbook can supply. Finally, students receive compensation for their services from their employers. Although students are not able to earn all of their college expenses, as a rule they can earn more than half.

Students interested in applying for admission to the cooperative plan should write to the Director, Cooperative Division, Georgia Institute of Technology, Atlanta, Georgia 30332-0260, for an information packet, including the necessary application form. Students may also contact the office by e-mail at gtcoop@coop.gatech.edu, or visit the website at: www.coop.gatech.edu/welcome.html

Multidisciplinary and Certificate Programs

Multidisciplinary Programs in the College of Engineering and Certificate Programs in the College of Sciences, the Ivan Allen College, and the DuPree College of Management offer students in good standing an opportunity to broaden their areas of expertise or acquire skills or information beyond their major degree requirements. Students interested in pursuing these programs should consult with their major school advisor.

For a description of Multidisciplinary and Certificate Programs offered in the College of Engineering, see page 122. For a description of similar programs in the College of Sciences, see page 275; in the Ivan Allen College, see page 215; and in the DuPree College of Management, see page 105.

Summer Language Program

The Language for Business and Technology Program at Georgia Tech offers an intensive summer program of study in German, French, Japanese, and Spanish coupled with an optional two-week seminar abroad (not yet available for Japan). During the six-week "immersion" program, students attend classes six hours per day, take part in special educational and social activities together, and live in a special section of a Georgia Tech residence hall. Students and their native speaker instructors converse only in the target languages.

The program is designed to take students who have a moderately low familiarity with the language (one year of college or two years of high school instruction) and move them to a level where they will be prepared to take advantage of overseas opportunities for work and study in a business or technological setting.

Upon completion of the summer program and the overseas seminar, students may earn up to 12 hours of credit. For further information, contact the Department of Modern Languages.

ROTC

Georgia Tech offers three voluntary ROTC programs that accept both men and women: Army, Navy, and Air Force.

Students may apply six hours of basic ROTC and nine hours of advanced ROTC as elective credit toward a degree. After earning a baccalaureate or graduate degree and completing the advanced ROTC courses for any of the three services, a student may receive a commission in either the reserve or regular forces.

Each ROTC unit offers scholarship programs of two, three, and four years. All juniors and seniors selected for the advanced courses receive a monetary allowance each month while enrolled in ROTC.

Preparation for Careers in High School Teaching

Students interested in pursuing careers in high school teaching may obtain secondary (high school) certification while pursuing their degree program at Georgia Tech. Through partnership with Georgia State University's College of Education, the program arranges for Tech students to cross-register for the necessary education classes. Many of these classes are taught on the Tech campus, but may also be taken at Georgia State, which is only a short distance from Georgia Tech. Those interested in pursuing this option should consult with academic advisors in the College of Sciences for assistance in structuring their academic program to include the required education courses.

Joint Enrollment Program for High School Students

High school students who have completed tenth or eleventh grade and have academic credentials comparable to those of scholastically superior first-year students at Tech may take courses at Georgia Tech. Courses taken at Georgia Tech will normally be at a level beyond those available in the student's high school. Courses completed at Georgia Tech can be used to satisfy high school requirements, and will also carry college credit.

Interested students should consult their high school counselor for specific program requirements. Applications for the program are available from the Office of Undergraduate Admission at Georgia Tech.

Preprofessional Programs

Georgia Tech degree programs offer a well balanced basic education in addition to outstanding training in the chosen field. As such, they provide an excellent basis for subsequent study of medicine, dentistry, veterinary medicine, or law. These professional programs typically require a limited number of courses in specific areas, which if not required as a part of the student's Georgia Tech degree program may be included as electives. Each academic department has preprofessional advisors who advise students in structuring their program of study to include the necessary courses to qualify for admission to professional school.

Georgia Tech has elected not to have majors designated as premedicine, predentistry, or prelaw. This approach to preprofesional education has two major advantages. First, students who elect not to enter professional school upon graduation are prepared for alternative careers immediately. Second, students who do continue to professional school have backgrounds that often provide them with unique opportunities within their selected profession. Examples include medical research, development of medical devices and apparatus, patent law, or the legal aspects of design and construction.

Professional schools typically admit students with strong academic credentials, a well balanced education, good communication skills, and a broad range of experiences. With the appropriate selection of elective courses, most majors at Georgia Tech provide suitable preparation for professional school in any area. No specific major offers an obvious competitive advantage in assuring admission to professional schools. The best choice of major is usually the one in which the student has the greatest inherent interest.

Special Academic Services

In an effort to assist its students in realizing their full intellectual potential, Georgia Tech sponsors a variety of voluntary programs designed to help the student overcome academic problems.

For assistance within a specific academic discipline, students should contact the appropriate college office (Architecture, Computing, Engineering, Management, Sciences, or Ivan Allen College). Other academic assistance programs are available through the Division of Student Affairs, the Department of Housing (Freshman Experience Program), OMED (Office of Minority Education Development), and other units of the Institute.

Learning Support

The Office of Academic Affairs administers the Learning Support Program. The College of Sciences offers college preparatory courses in mathematics, and the Ivan Allen College offers courses in reading and English composition for students who need further preparation before taking credit courses in English, mathematics, and history.

Students who are required by the Institute to take courses in the Learning Support Program will be notified in writing. They must then either test out of the program or register for the required course(s) before they can register for any credit courses that require Learning Support (LS) courses as prerequisites.

Students can test out of taking LS courses by passing the appropriate Georgia Collegiate Placement Exams administered before the beginning of each semester through the Office of Academic Affairs. Students who do not pass the appropriate examinations prior to their first semester in residence must register for the required LS courses. Students must pass all required LS courses and the appropriate Georgia Collegiate Placement Exams within their first three semesters in residence in order to register for any further course work. No more than 20 hours of degree credit work may be earned prior to exiting Learning Support.

In addition to those students who are required by the Institute to take LS courses, any student who wishes further preparation may register for one or more courses. LS courses are not prerequisite to credit courses when taken on this elective basis.

LS courses are offered on a pass/fail basis and may not be counted as hours toward graduation.

NOTE: Figures entered below the course number signify the number of class hours per week, the number of laboratory hours per week, and the semester-hour credit earned for the completed course, in that order.

LS 0199. Reading Skills 4-0-4.

Development of reading comprehension and speed, vocabulary, and study skills. Review of grammar and usage.

LS 0299. English Skills 4-0-4

Development of basic skills used in writing the sentence, paragraph, and short essay. Development of reading speed.

LS 0399. Mathematical Skills 4-0-4.

Intensive review of arithmetic and algebraic skills. Development of mathematics study skills.

Admissions

Freshmen may apply only for the summer or fall terms. Deadlines for submission of the Application for Admission (including the Leadership and Activity Record and Personal Statement), the nonrefundable $50 application fee, and all required credentials are as follows:

Term	Deadline
Summer	January 15
Fall	January 15

Transfer student deadlines for submission of the Application for Admission, a nonrefundable $50 application fee, and all required credentials are as follows:

Term	Deadline
Summer	April 1*
Fall	May 1*
Spring	October 1

**March 1 if seeking financial aid*

Students may apply for undergraduate admission by submitting the paper application and the nonrefundable $50 application fee or via the world wide web at the following website: www.enrollment.gatech.edu

Applicants who apply by computer must submit a $40 application fee and request that the official transcript(s) be mailed to the Office of Undergraduate Admission.

The Office of Undergraduate Admission will consider all applications on file by the stated deadlines provided spaces are available for the particular term or academic year for which the student applies. An application submitted after the deadline may receive consideration but only at the discretion of the Institute.

Transfer students should plan their transfer so as to allow ample time for their previous school to send transcripts to Georgia Tech. If Tech does not receive official final transcripts prior to the last day of registration, the Office of Undergraduate Admission will not allow the student seeking transfer to complete registration.

The *Guide to Undergraduate Admission,* designed to assist applicants with their enrollment at Tech, details policies and procedures concerning areas such as admissions requirements, acceptance notification, housing, financial aid, cooperative plan, joint enrollment, RETP, Dual Degree Program, and early admission. Applicants may obtain this publication from the Office of Undergraduate Admission.

For any information regarding admission to Georgia Tech, write to: Director of Undergraduate Admission, Georgia Institute of Technology, Atlanta, Georgia 30332-0320

Admission of International Students

International students who wish to enroll at Georgia Tech should write to the Office of Undergraduate Admission for a special information pamphlet describing application procedures and other basic information for applicants from foreign countries.

Advanced Placement/ Advanced Standing

Students entering Georgia Tech may receive college credit based upon their scores on the College Board Advanced Placement (AP) Tests, taken in conjunction with designated high school advanced placement classes. Minimum AP scores for earning college credit include: 4 on American government and politics, comparative politics, computer science, economics, English, French, German, psychology, history (American and European), and Spanish; and 5 in biology, chemistry, and physics.

English and chemistry credit may also be earned based upon scores on the College Board SAT II Subject Tests.

Students who have taken any of these tests should have their scores sent directly to Georgia Tech by the College Board.

International Baccalaureate

Subject	"Higher Level" Exam Scores	Georgia Tech Credit
American History	4 or higher	3 hours (HIST 2111)
Biology	5	4 hours (BIOL 1510)
Biology	6 or higher	8 hours (BIOL 1510, 1520)
Chemistry	5 or higher	4 hours (CHEM 1211)
Computer Science	5 or higher	3 hours (CS 1302)
English	4 or higher	3 hours (ENGL 1101)
Foreign Language	5 or higher	6 hours (1001-1002)
Math	4 or higher	4 hours (MATH 1501)
Physics	5 or higher	8 hours (PHYS 2211 & 2212)

These guidelines are subject to change without notice.

Departmental Exams

Advanced Placement credit is available in foreign languages and mathematics. For information regarding departmental exams and how your previous college course work will transfer to Georgia Tech, access the website at: www.gatech.edu/oscarweb/tec/

Readmission

Georgia Tech students who are not enrolled for two or more consecutive terms must apply for readmission. This application, with all pertinent supporting information, must be submitted to the Registrar's Office before the deadline for the term for which readmission is requested as listed below:

Term	Deadline
Fall	July 1
Spring	December 1
Summer	May 1

Former students on *drop* or *review* status should apply at least two months prior to these deadlines in order to ensure sufficient time for the review process. The section "Rules and Regulations" in this catalog contains additional information on readmission.

Students who withdraw from school (receiving all *Ws*) will not ordinarily be permitted to enroll the next succeeding term. If an exception is requested due to unusual circumstances, a Petition to the Faculty with an application for readmission must be filed.

Academic Advising

The faculty of each school must provide each student enrolled in that school the opportunity to consult with an informed advisor on the academic program and the selection of courses. Students should regularly seek assistance from their designated faculty advisors during their program of study, particularly when problems occur. Students who do not know the identity of their advisor should consult with the school director. Students undecided about their majors should seek advice from staff members in the office of the appropriate college dean.

Students must follow the approved curriculum of the academic school in which they are registered. Students who do not follow the approved curriculum may be denied registration privileges.

Freshman Admissions Requirements in 2001

In addition to the 16 units (one unit = one year) of high school course work currently required for admission to Georgia Tech, new freshmen entering in the summer or fall term of 2001 will be required to have an additional four units of high school course work, for a total of 20 units. The additional four units must be in academic courses, as defined by the applicant's high school.

Academic Regulations

The "Rules and Regulations" section of this catalog contains detailed information regarding the academic regulations of the Institute. Students who have questions concerning these regulations should consult either the general office of their major school or the Office of the Registrar, Room 104, Administration Building.

Grading System

For detailed information about the Georgia Tech grading system, see "Rules and Regulations," Section V, in this catalog.

Graduate Course Option

Students who complete both the bachelor's and master's in the same discipline at Georgia Tech may use up to six credit hours of graduate-level course work in the major discipline for both degrees. Recognizing that some master's degree programs do not have a unique undergraduate counterpart program, and that some master's programs are offered by several schools, the term "discipline" in the prior sentence will be broadly interpreted in such cases. In order to qualify for this option, the student must complete the undergraduate degree with a cumulative grade point average of 3.50 or higher and complete the master's degree within a two-year period from the award date of the bachelor's degree. Civil Engineering, Electrical Engineering, Engineering Science and Mechanics, Industrial and Systems Engineering, Mathematics, and Textile Engineering are the only schools currently participating in this program. The School of Mechanical Engineering participates but allows only three credit hours of graduate-level course work in the major discipline for both degrees.

Institute Rules for the Pass/Fail System

At the option of the major school, a student may receive up to a maximum of nine hours credit toward a bachelor's degree or three hours credit toward a graduate degree for courses taken under the pass/fail system with a grade of satisfactory. Such courses apply toward the degree requirements only if the major school has approved the course, either for all majors or for the individual student. The department or school offering a course determines the criteria for a passing grade and may restrict the pass/fail enrollment in any course it offers. The rules for withdrawal from graded courses apply to pass/fail courses as well.

Professors will record only a grade of *satisfactory* or *unsatisfactory* for any student so designated on the official class roll; students may not change their designation from credit to pass/fail or from pass/fail to credit after the last day to make schedule changes. Neither the professor nor the registrar may change a pass/fail grade to a letter grade, nor may the registrar include courses taken pass/fail in the calculation of grade point averages.

Under certain circumstances, a change in degree requirements may affect a department's position on a course previously approved for degree credit under the pass/fail system. In such cases, the student's major school will decide if a course completed with a grade of *pass* before the change will fulfill the amended requirements.

Only students who complete 91 or more hours toward a degree at Georgia Tech may use the entire maximum of 9 hours credit taken on pass/fail toward a bachelor's degree. For transfer students, second undergraduate degree students, and dual degree students, the number of hours completed at Georgia Tech determines the maximum number of pass/fail hours allowed, according to the following schedule:

Hours included in program of study	Hours allowed on pass/fail basis
45 to 70 credit hours	3 credit hours
71 to 90 credit hours	6 credit hours
91 or more credit hours	9 credit hours

Examination and Term Grades

The Institute schedules final examinations during the last week of each term, and term grades are posted on the Student Access System.

Scholastic Average

A student who passes a course receives both the designated number of credit hours and a number of quality points, calculated by multiplying the course credit hours and the numerical equivalent of the letter grade received ($A = 4, B = 3, C = 2, D = 1$). Thus, a student taking a three-hour credit course and earning a grade of *C* receives six quality points. To determine the undergraduate scholastic average, the total number of quality points earned by the student for all courses scheduled as an undergraduate is divided by the total number of credit hours scheduled; for the graduate scholastic average, only those courses scheduled by the student while enrolled in the graduate division are considered. If a student takes the same course more than once, the later grade does not replace the earlier one; rather, the scholastic average includes both grades. Courses taken pass/fail are not included in the calculation of the student's grade point average.

Second Undergraduate Degrees

To be a candidate for a second undergraduate degree, a student must obtain the recommendation of the faculty through the director of the school concerned. See "Rules and Regulations," Section XIII. F for detailed information.

Transfer Credit

Transfer credit is awarded on a course-for-course basis, not hour for hour. The basic policy regarding the acceptance of courses by transfer is to allow credit for courses completed with satisfactory grades (*C* or better) in other accredited colleges and universities in the United States and Canada, provided the courses correspond in time and content to courses offered at the Georgia Institute of Technology. Georgia Tech will not accept credit (except by examination) for courses successfully completed at another institution but previously failed at Tech. The student must request and file an official transcript of transfer courses before the Institute can award credit. Course work completed at colleges and universities outside the United States and Canada will be evaluated on a case-by-case basis.

Enrolled students at Georgia Tech must receive prior approval from the student's major school and the registrar before scheduling courses at other institutions. Students are not to be enrolled at Georgia Tech and another college without specific approval of the registrar and the appropriate faculty committee.

Auditors

Officially enrolled students who have obtained approval of their advisors and the department of instruction concerned may audit courses at Tech; however, the student will not receive credit for courses scheduled on an auditing basis. If the student wishes to change to or from auditing status, he or she must follow the procedure for schedule changes during the time allotted for schedule modification in the official calendar.

In order for a successful audit to show on the student's permanent record, the student must comply with all requirements listed by the instructor. If the instructor deems that the student did not successfully audit the course, the grade of *W* will be assigned.

All students registered as auditors must pay tuition at the regular rate. Members of the faculty or staff of the Georgia Institute of Technology may sit in on a course with the permission of the department concerned and the registrar.

Constitution and History Requirements

The Georgia law as amended March 4, 1953, requires that before receiving an undergraduate degree all students pass an examination or a comparable course in United States and Georgia history/constitution. Courses that fulfill the United States and Georgia history/constitution requirement are HIST 2111, 2112; POL 1101; PUBP 3000; or INTA 1200.

Regents' Testing Program

To establish eligibility for an undergraduate degree, every student in the University System of Georgia must pass the Regents' Test, an examination designed to measure proficiency in reading and English composition. Students are invited to take this examination when they have earned 10 hours of course credit. Any student accumulating 50 hours of course credit toward a degree without passing the Regents' Test must schedule remedial English or reading along with other credit course work. If a student fails in the first attempt, he or she must repeat the test. Alternative tests of competence and remediation are offered to non-native speakers of English. Alternative tests are offered for students with documented disabilities; tests must be approved through the Dean of Students' Office.

ROTC Credit

Students may apply a maximum of four hours in basic ROTC courses and six hours in advanced ROTC courses toward meeting the requirements for any degree. Students should begin taking basic ROTC courses during the first term they are enrolled. For further information, see individual curricula for the schools.

Wellness Requirement

All students attending Georgia Tech must satisfactorily complete a wellness requirement, HPS 1040 or 1061, during their freshman year. Other health and performance sciences (HPS) courses may be used as free electives or technical electives, if approved by the major school. Students should check the curricula of their individual schools to determine the number of hours they may apply toward the degree.

Core Curriculum Areas A-E

- CORE AREA A (Essential Skills)
- CORE AREA B (Institutional Options)
- CORE AREA C (Humanities/Fine Arts)
- CORE AREA D (Science, Mathematics, and Technology)
- CORE AREA E (Social Science)
- CORE AREA F (Courses related to degree and major)

CORE AREA A (Essential Skills, 9 sem. hours)
Area A is satisfied by completion of 10 semester hours as follows.

Required of all majors:

Course #	Course title	Sem. hrs.
ENGL 1101	Eng. Comp. I	3
ENGL 1102	Eng. Comp. II	3

Required of all students with majors in the colleges of Architecture, Computing, Engineering, and Sciences:

Course #	Course title	Sem. hrs.
MATH 1501	Calculus I	4

Required of all other majors:

Course #	Course title	Sem. hrs.
MATH 1712	Survey of Calculus	4
OR		
MATH 1501	Calculus I	4

CORE AREA B (Institutional Options, 4 sem. hours)
Area B is satisfied by completion of the following:

Course #	Course title	Sem. hrs.
CS 1301	Computer Sci. I	3

Plus 1 hour from Area A

CORE AREA C (Humanities/Fine Arts, 6 sem. hours)
Area C is satisfied by completion of 6 semester hours from the following lists.

Architecture, Industrial Design, and City Planning:
COA 2115, 2116, 2241, 2242; ARCH 2111, 2112; ID 2202; MUSI 3610, 3620; CP 4040

Literature, Communication, and Culture:
All LCC courses *except* LCC 2661, 2662, 3400, 3402, 3404, 3406, 3408, 3410, 3412, 3661, 3662, 4100, 4102, 4200, 4400, 4402, 4404, 4406, 4600, 4602, 4904, 4906

Modern Languages:
All CHIN courses beginning with CHIN 1002 *except* CHIN 4901, 4902
All FREN courses beginning with FREN 1002 *except* FREN 4901, 4902
All GRMN courses beginning with GRMN 1002 *except* GRMN 4901, 4902
All JAPN courses beginning with JAPN 1002
All LING courses *except* LING 3750, 4901, and 4902
All RUSS courses beginning with RUSS 1002 *except* RUSS 4901, 4902
All SPAN courses beginning with SPAN 1002 *except* SPAN 4901, 4902

Philosophy of Science and Technology:
All PST courses *except* PST 3790, 4790, 4791, 4792, 4901, 4902, 4903

CORE AREA D (Science, Mathematics, and Technology, 12 sem. hours)
Area D is satisfied by completion of 8 semester hours from the science list and 4 semester hours from the mathematics list.

Science:

Course #	Course title	Sem. hrs.
CHEM 1211	Gen. Chem.	4
CHEM 1311	Inorganic Chem. I	3
CHEM 1312	Inorganic Chem. Lab	1
BIOL 1510	Biol. Principles	4
BIOL 1520	Intro. to Organismal Biol.	4
EAS 1600	Intro. to Env. Field Science	4
EAS 1601	Habitable Planet	4
PHYS 2211	Intro. Physics I	4
PHYS 2212	Intro. Physics II	4

Mathematics:
All students with majors in the colleges of Architecture, Computing, Engineering, and Sciences will complete Math 1502. All other majors will complete:

Course #	Course title	Sem. hrs.
MATH 1711	Finite Math.	4
OR		
MATH 1502	Calculus II	4

CORE AREA E (Social Sciences, 12 sem. hours)

Area E is satisfied by completion of U.S./Georgia history and constitution legislative requirement with 3 semester hours from HIST 2111, 2112; POL 1101; INTA 1200; PUBP 3000 and 9 semester hours from the following list.

Architecture and City Planning:
ARCH 4126, 4335, 4770; CP 4010, 4020, 4030

History, Sociology, and History, Technology, and Society (HTS):
All HIST, SOC, and all HTS courses *except* HTS 2927, 2928, 2929, 4925, 4926, 4927, 4928, 4929

International Affairs:
All INTA courses *except* INTA 2010, 3750, 4400, 4901, 4902, 4903

Political Science and Public Policy:
All POL and PUBP courses *except* PUBP 3113, 3600, 4530, 4532, 4901, 4902, 4903, 4951, 4952

Economics:
All ECON courses *except* ECON 3110, 3120, 3150, 3160, 3161, 4060, 4170, 4301, 4321, 4910, 4990

Psychology:
PSYC 1101, 2010, 2020, 2103, 2210, 2220, 2230, 2240, 2260, 2300, 2400, 3060, 4070, 4770,

CORE AREA F (Courses related to degree and major, 18 sem. hours)

Area F varies with degree and major.

Note: 1. Courses completed at the 3000-4000 level may not satisfy the core curriculum Area C and Area E requirements for students transferring to other units of the University System of Georgia.

2. Any courses completed that were listed in prior catalogs as satisfying the Humanities/Social Science requirement and were completed while that catalog was in effect may also be used to satisfy this requirement.

Information for Graduate Students

General Information

The faculty of the Georgia Institute of Technology grants advanced degrees in engineering, science, management, computing, architecture, city planning, public policy, and other technology-related areas. The goals for graduate studies and research are to establish an educational environment that will encourage and assist students to develop their capabilities both as professionals and as human beings, to encourage students and faculty to vigorously pursue the discovery and generation of new knowledge through research, to investigate ways of applying such knowledge innovatively for the benefit of society and humanity, and to foster the development of new tools, objects, and ideas.

Students whose interests and aptitudes lead them beyond the limits of the traditional undergraduate curriculum may broaden their knowledge of a given field and pursue independent inquiry through graduate study. A graduate education is of particular benefit to students interested in careers in research, management development, design, or consulting; to those who aspire to formulate and administer policy; and to those who desire to enter the profession of education.

Degrees and Programs of Study

Master's Programs

Programs of study and research leading to the master of science are offered in the following disciplines:

Aerospace Engineering
Applied Physics
Architecture
Bioengineering
Biology
Chemical Engineering
Chemistry
City Planning
Civil Engineering
Computer Science
Earth and Atmospheric Sciences
Economics
Electrical and Computer Engineering
Engineering Science and Mechanics
Environmental Engineering
Health Physics
Health Systems
History of Technology
Human-Computer Interaction
Industrial Engineering
Information, Design, and Technology
International Affairs
Management
Management of Technology (Executive)
Mathematics
Materials Science and Engineering
Mechanical Engineering
Nuclear and Radiological Engineering
Operations Research
Physics
Polymers
Psychology
Public Policy
Statistics
Textile Chemistry
Textile Engineering
Textiles

Doctoral Programs

Programs of study and research leading to the Doctor of Philosophy are offered in the following disciplines and areas:

Aerospace Engineering
Algorithms, Combinatorics, and Optimization
Architecture

Bioengineering
Biology
Chemical Engineering
Chemistry
Civil Engineering
Computer Science
Earth and Atmospheric Sciences
Economics
Electrical and Computer Engineering
Engineering Science and Mechanics
Environmental Engineering
History of Technology
Industrial and Systems Engineering
Management
Materials Science and Engineering
Mathematics
Mechanical Engineering
Nuclear and Radiological Engineering
Operations Research
Physics
Psychology
Public Policy
Textile Engineering

To locate detailed descriptions of these programs and related courses, please refer to the index on pages 380-381 of this catalog. Areas of specialization may also be found under each program description.

The Institute may award degrees with or without designation of the field, based upon the recommendation of the school concerned.

Special Programs

Interdisciplinary Programs

The schools of the Institute authorized to offer graduate degrees develop and administer their own individual programs and work closely with one another to provide special study and research opportunities for students who wish to pursue a degree with a wider perspective than that presented by a single discipline.

Cooperation between academic units and various research centers and the development of informal programs based on areas of faculty interest have resulted in the establishment of interdisciplinary certificate programs in a number of areas, such as computer integrated manufacturing systems and microelectronics. The College of Engineering lists a large number of multidisciplinary programs on page 122 of this catalog. The College of Computing offers an interdisciplinary certificate in cognitive science, see page 91. The role of the DuPree College of Management in multidisciplinary programs is discussed on page 105. Multidisciplinary programs in the College of Sciences are discussed on page 275.

Video-based Instruction

For students who cannot attend daily classes on campus, graduate courses leading to master's degrees in electrical engineering, environmental engineering, health physics, industrial and systems engineering, and mechanical engineering are available by videotape. Students applying for video-based degree programs must meet the same admissions criteria as other degree-seeking students. For more information, see page 19 of this catalog.

Graduate Cooperative Program

Selected students planning to enroll for graduate study at Georgia Tech have the opportunity to participate in a unique cooperative program leading to advanced degrees in participating schools. Two plans are available. One is designed for Georgia Tech undergraduates who plan to continue as graduate students at Tech and includes study-work periods that span both undergraduate and graduate levels. Eligibility is based on academic achievement at Georgia Tech. The second plan is for graduate students whose undergraduate degrees may be from Tech or other institutions.

Degree requirements under this plan are identical to those for all students enrolled at Georgia Tech. The Graduate Cooperative Plan is designed as an enhancement to the educational programs of students working for advanced degrees and offers the benefits of added facilities and opportunities for external stimulation. In addition, students receive compensation for their services from companies that employ them.

Preliminary screening of students occurs at the school or college level. The participating companies select students on the basis of academic credentials and interest areas correlated with company activities. Many participating companies require U.S. citizenship or permanent residency. For students planning to participate both at the undergraduate and graduate levels, the program requires at least two work semesters at the undergraduate level and at least two work semesters at the graduate level. Students planning to participate only at the graduate level are required to work at least two semesters.

Academic credit for co-op work is available if the student, with approval of the major school, pursues research at the company that can be used to satisfy requirements for the thesis or other research paper.

Students interested in applying for admission to the Graduate Cooperative Plan should write to the Director, Graduate Cooperative Program, Office of Graduate Studies, Georgia Institute of Technology, Atlanta, Georgia 30332-0265.

The Academic Common Market

The Institute participates in the Academic Common Market Program managed by the Southern Regional Education Board. By interstate agreement, the market enables southern states to share academic programs. Residents of the participating states who qualify for admission and gain the approval of their state coordinators may enroll on an in-state tuition basis. Georgia Tech programs include: architecture (M. Arch.); city planning (M.C.P.); and city planning/architecture joint program (M.C.P./M. Arch.).

Policies and Regulations

The Graduate Committee, with the approval of the Academic Senate, is responsible for establishing academic policy for the graduate program; however, final authority rests with the Senate. This committee reserves the right to change requirements for degrees as may be appropriate. Students enrolled at the time such changes appear in the catalog have the privilege of following either the regulations stated in the catalog effective the semester in which they enrolled or the regulations in the catalog that records the change.

This catalog records the Institutewide policies and regulations that govern the graduate program. Schools may make additional rules concerning their programs and the pursuit of their degrees, but such rules may not contradict Institute policies and regulations.

Graduate Student Work Loads

A full-time graduate course load under the semester system is tentatively defined as at least 12 hours on a letter-grade or pass-fail basis. The advisor and school director may approve the substitution of one course (up to three hours) on an audit basis, excluding 8997 and 8998 courses. Full-time students working exclusively on thesis research should be registered for 18 to 21 hours of 7000- or 9000-level courses. The maximum load for graduate students is 21, and the minimum load for graduate students is three hours.

Students with fellowships, assistantships, traineeships, tuition waivers, or student visas and those assigned to the Institute by the armed forces for the purpose of pursuing a degree are required to be enrolled full time.

Staff Members

No staff member beyond the rank of instructor in a school may work for a master's degree in that school.

No new staff member with the rank of assistant professor in a school may work for a doctoral degree in that school.

Admissions Information

Applicants for the master's program should have received a bachelor's degree from a recognized institution and graduated in the upper half of their class. Students must show evidence of preparation in their chosen field sufficient to ensure profitable graduate study.

Ordinarily, the graduate school admits to the doctoral program only those students who have graduated in the upper quarter of their class.

Prospective students may obtain information and the necessary forms for admission from either the appropriate school or via the graduate admissions webpage at:
www.gatech.edu/admissions/grad/. Unless otherwise instructed by the major department, the student must submit the application, letters of recommendation, and official transcripts of previous academic work to the offices specified by June 1, November 1, and March 1 for fall, spring, and summer terms, respectively. Some programs have earlier deadlines, and some programs admit students for the fall term only. Students are advised to check with the graduate program of interest before applying. It is strongly

recommended that international students submit their materials at least six months before the proposed registration date. The $50 application fee may be waived for U.S. citizens and permanent residents receiving financial aid. Students applying for admission with financial assistance for any term are strongly advised to submit their materials by February 1 of the preceding academic year.

Graduate Record Examinations

GRE General test scores are generally required by all graduate programs with the exception of the Master of Science in Management and the Executive Management of Technology program, which require Graduate Management Admission Test scores. In addition, GRE subject test scores are required for applicants to the College of Computing and the Schools of Chemistry and Biochemistry and Mathematics.

Information concerning times and locations for these tests can be obtained from Graduate Record Examinations, Educational Testing Service, Box 6000, Princeton, New Jersey 08541-6000.

General information on the GMAT is available from Educational Testing Service, Box 966, Princeton, New Jersey 08540.

On-campus applicants may pick up GRE information from Graduate Academic and Enrollment Services and GMAT information from the DuPree College of Management.

Types of Standing

Applicants holding a bachelor's degree in an appropriate field from an approved institution will be accorded full graduate standing provided their previous work is of sufficient quality to indicate immediate success in advanced study.

If the work of an applicant holding an approved bachelor's degree is deficient in content or quality so that supplemental study or demonstrated ability is necessary, the applicant may be accorded conditional graduate standing.

Students who do not wish to qualify for an advanced degree at Tech, but demonstrate the potential benefits of their participation in advanced study, may gain admission as special graduate students. Students who are admitted with special standing for failure to submit official transcripts or for other administrative reasons may credit not more than 16 semester hours taken on special standing toward a degree.

Graduate students in good standing at other U.S. universities may enroll at Tech as transient graduate students by filing an application for admission and verification of good standing status from their registrar or graduate dean. Work undertaken in this standing will not apply, however, toward a Georgia Tech degree.

The undergraduate school, not the graduate school, will register students working toward a second bachelor's degree.

In addition to full, conditional, and special graduate standing, graduate students will be classified by academic standing according to their grade point averages—good standing, warning, probation, or drop. For specific information, see "Rules and Regulations," page 326.

The graduate average includes the grades on all courses scheduled by the student after admission to graduate study.

Readmission

Students who interrupt the continuity of their graduate programs by not registering for two or more consecutive terms must seek readmission by filing with the registrar a completed request for readmission form. Request forms are available from the registrar's office. For more information, see "Rules and Regulations," page 326.

Reactivation of Application

Applicants to a Tech graduate program who do not enter in the term for which they applied and subsequently wish to be considered for a later term must reactivate their application for the new term. Since the graduate admissions office keeps files on "never entered" students for one year only, students who delay more than one year in the reactivation request will have to supply a new set of application materials. To reactivate an application, the student must contact the graduate program to which he or she applied by June 1, November 1, or March 1 for the fall, spring, or summer terms, respectively. The number of reactivations per applicant is limited.

Undergraduate Students

Seniors with a grade point average of at least 2.7 may schedule graduate courses. In order to do so, the student must obtain permission both from the student's advisor and from the director of the school offering the course.

Credit toward the master's degree for up to 8 hours of courses taken as an undergraduate may be received under the following conditions.

1. The student was in residence at the Georgia Institute of Technology for at least two semesters before registering for the course(s).

2. The student did not apply credit for the course toward the baccalaureate degree. (See page 30, "Graduate Course Option," for special exceptions in certain schools.)

Registration

During the week preceding first registration, each new student should consult with the graduate coordinator of the major school to prepare a plan of studies and to receive instructions regarding registration procedures. Complete instructions on how and when to register can be found in the OSCAR (On-Line Student Computer Assisted Registration) bulletin.

Tech also conducts orientation for new fall graduate students just before registration.

Note: All new students must have submitted health forms to Student Health Services before they can register.

TOEFL for International Students

All international students from countries in which English is not the native language must take the Test of English as a Foreign Language (TOEFL). Since the results of this test constitute part of the material reviewed for admission to graduate study at Tech, students should arrange to have the Educational Testing Service send their scores to the graduate admissions office as early as possible. The minimum score for graduate admission required by Georgia Tech is 550 (paper-based) or 213 (computer-based). Some academic programs require higher scores.

Students who wish to take the TOEFL should obtain the *TOEFL Bulletin of Information for Candidates, International Edition.* Applicants can acquire copies of the *Bulletin* and the registration form through the offices of the U.S. Information Service (USIS), American embassies and consulates, and U.S. educational commissions and foundations in a number of cities outside the United States. In addition, several private organizations distribute the *TOEFL Bulletin*. These groups include the Institute of International Education (IIE); the African-American Institute (AAI); the American Mideast Educational and Training Services (AMIDEAST); and the American-Korean Foundation.

Students who cannot obtain a *TOEFL Bulletin* and registration form locally should write well in advance of application to Test of English as a Foreign Language, Box 6151, Princeton, New Jersey, 08541-6151, USA.

Transfer of Credit

A student may not apply for transfer credit until after matriculation at Georgia Tech. The courses to be transferred would typically be those appearing on the approved program of study form for the master's degree. A doctoral student normally does not request transfer credit. The rules relative to and the process for obtaining transfer of credit for graduate-level courses are as follows.

1. A student may receive transfer credit (up to six hours) for graduate-level courses taken at an accredited institution in the United States or Canada and not used for credit toward another degree. The student must supply a current transcript for this evaluation.

2. To obtain transfer of credit, the student must complete the following procedure: (a) The student will confer with the graduate advisor to ascertain whether the courses to be transferred are a logical part of the student's graduate program. (b) If the courses are appropriate, the student will deliver to the school that teaches such courses a copy of the current transcript, necessary descriptive materials including catalog descriptions, and textbooks used for evaluation. The faculty of the appropriate school will determine the equivalent Georgia Tech course and the number of credit hours accepted. The faculty member who prepares the transfer credit form should have the school director cosign it. The school should then send the form directly to the registrar with a copy of the student's Approved Program of Study attached. (c) If the student wishes to transfer more than six hours, a petition must be submitted to the graduate committee including statements of possible justification for the granting of such a petition,

transfer credit forms, and the recommendation of the student's school director.

3. A joint enrollment student may receive graduate credit for up to one-third of the hours required for the degree for graduate courses taken at Emory University or Georgia State University provided that (a) Georgia Tech does not offer such courses, (b) the student's advisor and school director approve the courses in writing in advance, and (c) the student passes the courses with a grade of *C* or better. "Advance approval" is satisfied when the courses appear on the student's proposed program of study.

4. A student may not receive transfer credit from universities outside the United States and Canada; however, an international student can obtain credit for courses previously taken but not applied toward another degree by filling out an "Examination for Advanced Standing Authorization Request Form," paying the appropriate fee at the Cashier's Office, and passing the examination for advanced standing. The school or department that normally teaches the equivalent course will administer any necessary examinations.

The Master's Degree

Enrollment Requirements

While students may enroll in the master's degree program upon admission with either full or conditional standing, all conditions must be met and the student's status changed to "full" in order to graduate with the master's degree.

Students enrolled for the master's degree must register for at least one semester per year in order for the original requirements for their degree to remain unchanged. In other cases, the school may re-evaluate the student's credentials and impose additional degree requirements.

Students who have completed all course work and are planning to submit a thesis in partial fulfillment of the requirements for a master's degree should register for research hours ("MAJR7000") consistent with a realistic appraisal of the amount of remaining thesis work and required faculty involvement. Students will not receive thesis guidance during any term for which they are not registered.

Students must be enrolled a minimum of three hours in the semester of graduation.

The Institute has no residency requirements for the master's degree.

Program of Study

The student, in conference with the faculty advisor, should prepare a program of study for the master's degree as a guide for planning an academic schedule. In some cases, the student's school may require that the proposed program be submitted to the director of that school for approval.

The program of study must be completed satisfactorily within 6 consecutive calendar years and must include, at a minimum, 30 approved credit hours distributed as follows:

With thesis:

Minimum course credit hours in major field (a basic field of knowledge, not a department of specialization)	12
Minimum course credit hours at 6000 to 9000 level	12
Total course credit hours for degree	18
Thesis hours (7000)	6
Total credit hours	30

Without thesis (must have approval of school director):

Minimum course credit hours in major field (a basic field of knowledge, not a department of specialization)	18
Minimum course credit hours at 6000 to 9000 level	21
Total credit hours	30

Some schools require more than the minimum credit hours. Please refer to specific academic program descriptions for more detailed information.

Other than thesis hours, the student may use only three hours under the pass/fail designation in the approved program of study (see p. 30). As a rule, a course may not be counted toward more than one degree.

Undergraduate courses required for graduation in the discipline (designated degree) or discipline-of-origin (undesignated degree) at Georgia Tech may not be applied toward a master's degree. (See page 30, "Graduate Course Option," for special exceptions in certain schools.)

The Master's Thesis

To complete the requirements for the master's degree, the student must submit a master's thesis unless the school director determines that additional course work is of more importance in meeting approved objectives.

Students who meet the requirements for the master's degree by completing a combination of course work and thesis must register for a minimum of six hours of thesis credit. (See Program of Study.)

A candidate whose program includes a thesis must present a treatise in which the results of an investigation directed by a member of the faculty of the Institute are set forth in clear, articulate form. The purpose of the thesis is to further the educational development by requiring the student to plan, conduct, and report an organized and systematic study of importance.

The *Manual for Graduate Theses*, available from the graduate office, specifies the requirements for the thesis.

Requirements for Master's Degree

1. Petition to graduate: To apply for master's degree candidacy, the student must submit to the registrar, during the semester preceding the anticipated final semester of work, the petition for a degree with the approved program of study attached.
2. Approved Program of Study (must accompany petition to graduate): The student's approved program of study must show that course requirements for the master's degree will be satisfied during the final semester (see Program of Study).
3. The Approved Program of Study must be successfully completed within a period of no more than six consecutive calendar years.
4. The student must have an overall grade point average of at least 2.7 and satisfy all school academic requirements.
5. The student must have completed satisfactorily any language requirement imposed.
6. The student must have passed any qualifying or comprehensive examinations required by the student's school.
7. The student must have filed with the Office of Graduate Studies and Research an approved thesis topic and have made satisfactory progress on the thesis if it is a part of the approved program.

Requirements for Award of the Master's Degree

8. The student must receive final acceptance of the thesis from the graduate office and submit three unbound copies.
9. The student must be registered for a minimum of three credit hours in the semester of graduation. A waiver of this requirement may be obtained only if all requirements for graduation, including submission of the final approved thesis, have been met prior to the last day of registration and the student was registered for the preceding semester.
10. In addition, the student must have completed any required work outlined at the time of matriculation.

Language Requirement

The student's school may require a reading knowledge of one appropriate language.

The Doctoral Degree

The degree of Doctor of Philosophy recognizes demonstrated proficiency and high achievement in research. After adequate preparation, the candidate must successfully complete both comprehensive examinations in his or her academic field and complete a searching and authoritative investigation of a special area in the chosen field, culminating in a written dissertation.

Enrollment Requirements

The matriculation requirements are similar to those outlined for the master's degree with the addition of the residency requirement: doctoral students must spend at least two full-time semesters in residence at the Georgia Institute of Technology and ordinarily must complete research for the dissertation while in residence. Under special circumstances, candidates who have met the residence requirement may receive permission to pursue their research in absentia, provided the director of the appropriate school approves and a faculty member directs the project.

In either case, doctoral students working full time on thesis research should be registered for a full course load of "9000" dissertation hours each semester.

While no fixed course requirements apply for the doctoral degree, the student's thesis advisory committee may recommend graduate course work in both a major and a minor field of study.

Admission to Candidacy

Doctoral students customarily apply for degree candidacy after completing at least three semesters of course work beyond the B.S. degree.

To qualify for candidacy, students must

- complete all course requirements (except the minor);
- achieve a satisfactory scholastic record;
- pass the comprehensive examination; and
- file with the school director and the Office of Graduate Studies a formal statement naming the dissertation reading committee and delineating the research topic.

Upon satisfactory completion of these requirements, with approval of the dissertation topic, the graduate school formally admits the applicant to candidacy for the degree.

The Comprehensive Exams

The comprehensive examination assesses both general knowledge of the degree area and specialized knowledge of the student's chosen research field. Each school is responsible for scheduling comprehensive examinations at least once a year, in the fall or spring, and for informing students of their scope. A guidance committee appointed by the director of the school will advise each student in planning a program of study and preparing for the examination, partly through an initial evaluation of the student's background and interests, partly through periodic consultation to evaluate and aid the student's progress.

Time Limit for Degree Completion

Students must complete all degree requirements within five years from the end of the term in which they pass the comprehensive examination and must have an overall grade point average of 2.7 in order to graduate.

Prior to the student's admission to candidacy, the candidate will present for the approval of the school chair or college dean, and the Office of Graduate Studies, a formal statement naming the student's dissertation advisor and setting forth the topic selected for investigation, the objectives the student hopes to gain, and the steps by which the student proposes to achieve them. The dissertation topic must give promise of being either a genuine addition to the fundamental knowledge of the field or a new and better interpretation of facts already known.

The Minor Field of Study

In addition to an adequate knowledge of the major field of intended research, the student must demonstrate mastery of some other, smaller body of knowledge—the minor field—preferably outside the student's particular school. The purpose of the minor is to encourage a wider interest on the part of the student and to provide a broader basis for the evaluation of the student's capabilities.

The minor will normally consist of at least nine semester hours of work in related courses, chosen by the student in consultation with a guidance committee and approved by the Office of Graduate Studies. These courses should be at the 6000 level or above, but certain 4000-level courses may also be used with proper approval. Courses taken at other institutions may be included in the minor. Once the student has satisfactorily completed the minor, the school director sends a confirmation, accompanied by course grades, to the graduate office for final approval and recording.

Although the student need not complete the minor as a prerequisite for admission to candidacy, the chosen field must be submitted for approval and the program of study must be completed before clearance for the degree.

Language Requirements

The student's school may require a reading knowledge of one or more foreign languages.

The Dissertation

Thesis Topic

The dissertation topic must give promise of being either an addition to the fundamental knowledge of the field or a new and better interpretation of facts already known. It must demonstrate that the candidate possesses powers of original thought, talent for research, and ability to organize and present findings.

The dissertation must meet the criteria published in the *Manual for Graduate Theses*, which is available in the Office of Graduate Studies.

The Doctoral Examination

If the dissertation advisory committee finds the dissertation satisfactory, it schedules the candidate for an oral examination on the subject matter for the dissertation and the field in which it lies. An examining committee approved by the Office of Graduate Studies will conduct the examination.

If a candidate should fail to pass the final oral examination, the examining committee may recommend permission for one additional examination. In the case of failure, the registrar does not receive a report of the examination results.

Additional Graduation Requirements

In addition to requirements listed elsewhere, the candidate must:

1. submit a petition for the degree to the registrar during the term preceding the anticipated final term of work. Petition forms are available from the registrar's office.
2. register for at least three hours in the term in which the final examination occurs and for the term of graduation. A waiver of this requirement may be obtained only if all requirements for graduation, including submission of the final approved dissertation, have been completed prior to the last day of registration, and the student was registered for the preceding term.
3. pay the Institute a fee of $50 for microfilming the dissertation through University Microfilms Inc. prior to the final submission of the completed dissertation to the graduate office.

If both the dissertation and the examination are satisfactory and the candidate has completed the requirements of residence, minor field, and any additional school requirements, the Office of Graduate Studies will certify the candidate as qualified to receive the degree of Doctor of Philosophy.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Financial Information

Classification of Students for Tuition Purposes

Under the Constitution and laws of Georgia, the Board of Regents of the University System of Georgia was created to govern, control, and manage a system of public institutions providing quality higher education for the benefit of Georgia citizens. The state, in turn, receives substantial benefit from individuals who are attending or who have attended these institutions through their significant contributions to the civic, political, economic, and social advancement of the citizens of the state of Georgia.

Because the overwhelming proportion of financial support for the operation of the public institutions of higher education in Georgia comes from the citizens through the payment of taxes, the determination of whether a student is classified as a resident or a nonresident of the state for tuition purposes becomes a significant matter. The tuition paid by in-state students covers only about one-fourth of the total cost of their education in the University System. Therefore, Georgia taxpayers are contributing three-fourths of the necessary funds to provide quality education for the citizens of the state.

The practice followed by state colleges and universities of assessing out-of-state students a higher tuition rate is a rational attempt by states to achieve a partial cost equalization between those who have and those who have not recently contributed to the state's economy, even though no precise way exists to determine the degree to which higher tuition charges equalize the cost of educating in-state and out-of-state students.

Courts that have been faced with challenges to residency classification procedures have consistently recognized the right of public institutions of higher education to charge higher rates to out-of-state students and to adopt reasonable criteria for determining the establishment of in-state status.

For the purpose of these regulations, the question to be answered is not primarily whether a student is a resident or nonresident of Georgia, but rather whether the student meets the criteria to pay University System fees on an in-state basis. The term "resident" is confusing because it may have several definitions as it relates to voter registration, driver's licenses, automobile registration, deeds, contracts, wills, income taxes, and other matters. A student may be a resident of Georgia for some purposes, but not entitled to in-state status for tuition purposes.

The Board of Regents has adopted certain policies governing the classification of students as residents and nonresidents for tuition purposes in keeping with its responsibilities to the citizens of Georgia for an appropriate assessment of fees and to ensure that out-of-state students pay a fair and reasonable share of the cost of their education. The taxpayers of Georgia are thereby assured that they are not assuming the financial burden of educating persons whose presence in the state is not intended to be permanent.

With these considerations in mind, the Board of Regents has adopted the following policies governing the classification of students for fee payment purposes.

1. (a) If a person is 18 years of age or older, he or she may register as an in-state student only upon showing that he or she has resided in Georgia for a period of at least 12 months immediately preceding the date of original enrollment.

   (b) No emancipated minor or other person 18 years of age or older shall be deemed to have gained or acquired in-state status for tuition purposes while attending any educational institution in this state, in the absence of a clear demonstration that he or she has in fact established legal residence in this state.

2. If a person is under 18 years of age, he or she may register as an in-state student only upon showing that his or her supporting parent or guardian has been a legal resident of Georgia for a period of at least 12 months immediately preceding that date of registration.

3. If a parent or legal guardian of a minor changes his or her legal residence to another state following his or her legal residence in Georgia, the minor may continue to take courses for a period of 12 consecutive months on the payment of in-state tuition. After the expiration of the 12-month period, the student may continue his or her registration only upon the payment of fees at the out-of-state rate.

4. In the event that a legal resident of Georgia is appointed as guardian of a nonresident minor, such minor will not be permitted to register as an in-state student until the expiration of one year from the date of court appointment, but only upon a proper showing that such appointment was not made to avoid payment of the out-of-state fees.

5. Aliens shall be classified as nonresident students provided, however, that an alien who is living in this country under an immigration document permitting indefinite or permanent residence shall have the same privilege of qualifying for in-state tuition as a citizen of the United States.

6. Waivers: An institution may waive out-of-state tuition for:

(a) nonresident students who are financially dependent upon a parent, parents, or spouse who has been a legal resident of Georgia for at least 12 consecutive months immediately preceding the date of registration provided, however, that such financial dependence shall have existed for at least 12 consecutive months immediately preceding the date of registration;

(b) international students selected by the institutional president or his authorized representative may be enrolled upon the payment of in-state tuition provided that the number of such waivers in effect does not exceed 1 percent of the equivalent full-time students enrolled at the institution in the fall semester immediately preceding the semester for which the out-of-state tuition is to be waived;

(c) full-time employees of the University System, their spouses, and their dependent children; and full-time employees of the State Board of Technical and Adult Education programs, their spouses, and their dependent children;

(d) nonresident graduate students who hold teaching or research assistantships requiring at least one-third time service at such institution;

(e) full-time teachers in the public schools of Georgia and their dependent children. Teachers employed full time on military bases in Georgia shall also qualify for this waiver;

(f) career consular officers and their dependents who are citizens of the foreign nation that their consular office represents and who are stationed and living in Georgia under orders of their respective governments. This waiver shall apply only to those consular officers whose nations operate on the principle of educational reciprocity with the United States; and

(g) military personnel and their dependents stationed in Georgia and on active duty unless such military personnel are assigned as students to System institutions for educational purposes.

Students who come to Georgia Tech from another state and work for companies in Georgia **remain ineligible** for in-state tuition in the absence of compelling evidence of intent to remain in Georgia permanently. Having Georgia voter registration, having employment in any position normally filled by a student (such as co-op, graduate research assistant, or graduate teaching assistant), having a lease of living quarters, having a Georgia automobile registration, and having a Georgia driver's license do not constitute sufficient evidence of domicile to affect classification as an in-state student under the Board of Regents' policy.

For further information concerning residency, students should contact the Residency Office, Room 103, Administration Building, in writing or by telephone at (404) 894-6388. The Residency Office must receive an application for classification as a legal resident for fee payment purposes no later than one month prior to the academic registration date for the term in which the student seeks to pay fees as a resident of Georgia. Requests for tuition waivers must be received by the Registrar's Office no later than the last day of registration for the term for which the out-of-state tuition is to be waived.

Obligations of Students

An individual is officially enrolled at Georgia Tech upon payment of all applicable matriculation, tuition, transportation, student activity, athletic, and student health fees for the current term. Upon enrolling, every student is obligated to remit, return, or submit all other financial obligations that may become due, as well as property or records of the Institute, within the time prescribed by the Institute. Failure to fulfill any such obligation will result in denial of registration privileges for subsequent term(s). Such denial of registration privileges is in addition to and apart from any disciplinary measures that may be taken pursuant to the Student Conduct Code, "Rules and Regulations," p. 341.

It is the responsibility of the student to be informed of and to observe all regulations and procedures regarding the payment of fees and the entitlement to refunds. In no case will a regulation be waived or an exception be granted because a student pleads ignorance of the regulation or asserts that he or she was not informed of it by an advisor or other authority. All questions concerning fees and refunds should be directed to the Bursar's Office only. Verbal misinformation is not grounds for a waiver of a regulation.

All fees are payable by the deadline published in the Schedule of Classes for each academic term. Registration is not complete until all fees have been paid. Payment may be made either in cash (at a Teller Window in the Bursar's Office) or by check payable in U.S. currency and drawn on a financial institution in the United States of America or by Visa, Mastercard, or Discover. Credit card payments may be faxed to the Bursar's Office. The Institute reserves the right to determine the acceptability of all checks. All checks not drawn in this manner will be returned to the remitter of the check. Counter checks are not acceptable. If a check given in payment of a student's fees, books, supplies, or residence hall rent is not paid upon presentation to the bank on which it is drawn, an academic hold will be placed on the student's records. A student with an academic hold on his or her record will not be permitted to register for further course work or receive, or have forwarded to external third parties, transcripts of grades until the financial obligation represented by the returned check plus a returned check fee of $15 or 5 percent of the face amount of the check, whichever is greater, has been paid. Any person who issues an "insufficient funds" or "no account" check may have violated the statutes of the state of Georgia. This person may not only be permanently withdrawn from the Institute, but may also face legal prosecution. Any person who has a check returned by the bank for any reason should settle that obligation promptly. Failure to do so may result in the placing of the account for collection by a professional collection agency, with the student incurring the full cost of collection.

All matriculation and other charges are subject to change without notice.

The Georgia Institute of Technology reserves the right to withhold goods and services for outstanding financial obligations owed to the Institute.

Fees

A nonrefundable fee of $50 must accompany all applications for admission to the Georgia Institute of Technology. Upon registration, part-time students (those carrying less than 12 credit hours per semester) who are legal residents of Georgia pay an estimated $64 per credit hour and a transportation fee of $23. Nonresident part-time students pay an estimated $257 per credit hour ($64 matriculation and $193 tuition) and a transportation fee of $23.

All students scheduling six hours or more must pay the student activity fee estimated at $50, the athletic fee estimated at $33, the health service fee estimated at $71, and the technology fee estimated at $50.*

Since changes in fees may occur without notice, the student must refer to information provided on registration day by the Office of the Senior Vice President for Administration and Finance for official amounts on fees and other institutional charges for each individual term.

**All figures are estimated pending final determination by the Board of Regents and the senior vice president for Administration and Finance at Georgia Tech.*

Late Registration Fee

Students who do not meet fee payment deadlines may incur penalty fees. If a student does not pay all required fees by the published fee deadlines, his or her registration may be cancelled. The late payment fee is $75.

Laboratory and Breakage Fees

Chemistry Breakage Cards may be purchased at the Bookstore.

Account Summaries

Students who require a copy of their account status may request one at any time from the Bursar's Office.

Other Fees

The fees listed here do not include fraternity, club membership, or personal transportation expenses.

Most requests for student transcripts are free of charge. (Federal Express is $15.50 per copy.)

Each accepted applicant for admission to the fall semester must submit a deposit (in addition to the residence hall room deposit) as stated in the letter of admission. This deposit will be applied against fees assessed for students who attend the Georgia Institute of Technology.

A candidate for the doctoral degree must pay a charge of $50 for microfilming the dissertation and depositing it with the University Microfilms Service. The Institute assumes the cost of binding the three library copies of a student's thesis or dissertation.

Each student petitioning for graduation must pay a graduation fee upon submitting the petition. The charge is currently $25. Students must pay this fee each time they submit a petition for graduation.

Georgia Tech reserves the right to charge a fee for the use of Institute property and to levy fines for the improper use of Institute property.

Refund of Fees

If a student must withdraw from the Institute, the administration will consider requests for fee refunds only through written application. The student should obtain an "Application for Withdrawal" from the Registrar's Office and submit the form, dated and signed, to the Bursar's Office, located in Lyman Hall, by the deadline published in the Schedule of Classes for each academic term.

Students withdrawing on or before the last day to register are entitled to a 100 percent refund. Students withdrawing during the four-week period beginning with the first day after registration are entitled to a refund of a certain percentage of matriculation and tuition fees paid for that term.

Students should refer to the Schedule of Classes for specific dates and times of each refund period. The date to be used in determining eligibility for a refund will be the date the withdrawal is executed in the Office of the Registrar.

After the last day to register without penalty, the following students are not entitled to any refund of fees paid:

- Students who withdraw after the fifth Friday after classes begin
- Students who have been suspended for disciplinary reasons
- Students who leave the Institute when disciplinary action is pending
- Students who do not withdraw formally
- Students who drop individual classes

A stop payment of a check does not constitute a formal withdrawal. There will be a returned check fee of $15 or 5 percent of the face amount of the check, whichever is greater, as previously stated; the student will be held liable for tuition and fees until the date of official withdrawal.

Undergraduate Financial Assistance

The Office of Student Financial Planning and Services at Georgia Tech assists students in the search for financial assistance to meet normal college expenses. Our desire is to provide assistance by assigning Institute funds or by directing students to other sources. The Office of Student Financial Planning and Services receives and administers all funds provided to Tech for undergraduate student assistance, including awards forwarded to the Institute from outside agencies for the use of designated students. Because Georgia Tech will assist students either by awarding funds or by directing the student to other sources of aid, no student should fail to consider attending Tech because of financial problems. However, the financial aid applicant should realize that the amount of aid granted seldom meets all educational expenses, and financial assistance from the Institute will require supplements from the student, family members, and outside sources.

The primary responsibility for financing an education rests with the student and the student's family. Students may receive assistance through scholarships, grants, loans, employment, or a combination of these programs. Of course, the student should help to defray expenses through

Undergraduate Information

*Estimated Costs (1999-2000 Academic Year)	Resident of Georgia	Nonresident of Georgia
Semester Fees		
Matriculation	$ 1,213	$ 1,213
Nonresidence	$ 0	$ 3,639
Transportation	$ 40	$ 40
Student Activity	$ 75	$ 75
Health Service	$ 107	$ 107
Athletic	$ 50	$ 50
Technology	$ 75	$ 75
Subtotal	$ 1,560	$ 5,199
Books and Supplies	$ 450	$ 450
Room and Board	$ 2,850	$ 2,850
Personal Expenses (clothing, laundry, recreation, travel, etc.)	$ 750	$ 750
Total Per Semester	$ 5,610	$ 9,249
Total Per Year (2 semesters)	$11,200	$18,497

**Semester fees shown in this chart are estimated for the 1999-2000 academic year only. Final figures approved by the Board of Regents were not available at the time of printing. Final figures for the 1999-2000 academic year will be available in June 1999.*

summer or part-time jobs. Georgia Tech's Career Services Office attempts to keep an up-to-date listing of employment opportunities and can provide more information for interested students. In addition, the Cooperative Program, which is not formally a financial aid program, allows approximately one-fifth of the undergraduate enrollment in the fields of engineering, science, and management to pay part of their college expenses by earning $6,000 to $8,000 per year. Financial need is not a prerequisite for consideration in the Co-op Plan. Co-op participants are considered for financial aid based upon the same analysis used for other students. Students desiring more information on the Cooperative Program should contact: Director, Cooperative Division, Georgia Institute of Technology, Atlanta, Georgia 30332-0260.

All entering students, including transfer students, who are interested in scholarships, grants, loans, and/or work opportunities for any semester of the academic year beginning in June and/or September must submit the Georgia Tech Application for Scholarship and Financial Aid and a Free Application for Federal Student Aid (FAFSA). The priority application deadline for entering freshmen is March 1; the deadline for returning undergraduates, transfers, and graduate students is April 15. Georgia Tech must receive valid Student Aid Report (SAR) data from the federal processors by the March 1st and April 15th dates. Entering freshmen who meet the March 1st deadline usually receive estimated financial aid awards by mid-April. Returning undergraduates, transfers, and graduate students who meet the April 15 deadline receive financial aid awards by mid-May.

For additional information and the *Guide to Financial Aid*, please contact the Office of Student Financial Planning and Services, Georgia Institute of Technology, Atlanta, Georgia 30332-0460.

Special courses may require an additional fee. Graduate students carrying a full academic load (12 credit hours or more per semester) must pay the full amount of all fees as shown on page 51.

Part-time students who are carrying between 6 and 11 credit hours per term and who are legal residents of Georgia must pay approximately $101 per credit hour in satisfaction of the matriculation fee and $307 for the athletic, student activity, medical, and technology fees. Students carrying fewer than 6 credit hours pay only the matriculation fee and the transportation fee. All nonresident part-time students will have an additional tuition fee of approximately $303 per credit hour. A student must enroll for a minimum of three hours. All students must pay the $40 transportation fee.

Note: Conditions may arise beyond the control of the Georgia Institute of Technology that will cause the rate for tuition and fees to be changed during the next year without notice.

President's Scholarship Program

The President's Scholarship is Georgia Tech's premier merit-based scholarship. Recipients are selected from among the nation's best high school seniors, based on demonstrated excellence in leadership and academic performance. From the applicant pool, students selected as semifinalists will be asked to be interviewed and to submit teacher recommendations. The top semifinalists will be named finalists and invited with their parents to campus for an interview and information weekend in March.

Each year approximately 75 incoming freshmen receive President's Scholarships, which are renewable for up to four academic years contingent upon honors-level performance and continued leadership development as evidenced by involvement in campus or community activities. Awards for students who entered in fall 1998 were worth up to $5,000 per year for Georgia residents and up to $10,000 per year for non-Georgia residents. Amounts for future years may change.

To apply, a student must be a U.S. citizen or permanent resident, apply as an incoming freshman (transfer students are not eligible), and submit the Georgia Tech Application for Undergraduate Admission with a postmark no later than October 31.

For more information, contact the President's Scholarship Program at (404) 894-2691 or psp@success.gatech.edu, or view the webpage at: www.enrollment.gatech.edu/psp

Medals and Prizes

Fraternities, academic schools and departments, professional groups, and community organizations award medals and prizes, such as the Phi Kappa Phi Award, and present them at the annual Honors Day exercises.

Graduate Financial Assistance

The Institute offers financial aid from a variety of sources to assist students with the pursuit and completion of their degrees as rapidly as circumstances permit. Some of these are briefly described here.

Students should address inquiries for financial assistance to the director of the school in which they plan to study. Graduate school applicants should also investigate national fellowships offered by various foundations, professional organizations, and government agencies.

President's Fellowships

Each year the Institute awards fellowships to supplement other awards to full-time doctoral matriculants with outstanding academic records and high research potential. The fellowship supplement consists of an annual $5,000 stipend (three semesters). These fellowships are renewable for three additional years, based on the major school's evaluation and recommendation.

President's Minority Fellowships

These fellowships are awarded to a select number of outstanding minority doctoral matriculants with outstanding academic records and high research potential. The $5,000 award (three semesters) supplements other support such as departmental assistantships or fellowships. The awards are renewable for three additional years, based on the major school's evaluation and recommendation.

Graduate Research Assistantships

Students ordinarily receive these awards on a one-third or half-time basis. Full-time students with at least one-third time appointments pay matriculation fees of $25 (plus student fees), and do not pay nonresident fees. Student fees are the same for all students.

Graduate Teaching Assistantships

Schools and departments ordinarily offer these awards on a one-third or half-time basis. Full-time students with at least one-third time appointments pay matriculation fees of $25 (plus student fees), and do not pay nonresident fees. Student fees are the same for all students.

Graduate Information

*Estimated Costs (1999-2000 Academic Year)	Resident of Georgia	Nonresident of Georgia
Semester Fees		
Matriculation	$ 1,402	$ 1,402
Nonresidence Tuition	$ 0	$ 4,206
Transportation	$ 40	$ 40
Student Activity	$ 75	$ 75
Health Service	$ 107	$ 107
Technology	$ 75	$ 75
Athletic	$ 50	$ 50
Total	$ 1,749	$ 5,955
Total per Year (2 semesters)	$ 3,498	$11,910

**Semester fees shown in this chart are estimated for 1999-2000 only. Final figures approved by the Board of Regents were not available at the time of printing. Figures for the academic year will be available in June 1999.*

Federal Fellowships and Traineeships

The Institute participates in a number of fellowship and traineeship programs sponsored by agencies of the federal government.

In addition, the following traineeships associated with specific training programs are available: water resources planning and management through the Environmental Resources Center, radiation health specialist training program through the School of Mechanical Engineering's Nuclear and Radiological Engineering Program, air quality control through the School of Chemical Engineering, and minerals and mining through the School of Materials Science and Engineering.

Out-of-State Tuition Waivers

School directors may recommend to the Graduate Office a limited number of academically outstanding nonresident full-time students for waiver of nonresidence fees.

Local Industry Work-Study Programs

Many industries located in and around Atlanta offer opportunities to pursue graduate degrees as an integral part of their employee training programs. In such a plan, the student may work and study on a reduced-work-week schedule that is compatible with school, student, and company requirements. Additionally, the company may choose to pay academic fees, costs of texts, and a supply allowance.

Veterans Services

Because the Department of Veterans Affairs (VA) must receive certification of enrollment before issuing benefit payments, any student planning to enroll under any of the VA programs should initiate the certification procedure through the Georgia Tech Office of the Registrar as early as possible. For further information about the certification procedure, contact the Office of the Registrar, or the local Atlanta Veterans Administration at 730 Peachtree Street, Atlanta, Georgia 30365 (1-888-GIBILL-1).

Veterans Services information is also available on the Office of the Registrar website at www.registrar.gatech.edu.

Veterans must apply to Georgia Tech through the usual admissions procedure. Eligibility for VA benefits does not guarantee acceptance to the institution, nor does acceptance to Tech signify eligibility. The institution serves only as a source of certification and information to the Veterans Administration; the student must carry out all financial transactions with the Veterans Administration directly.

Sponsored Fellowships

The Institute awards a number of fellowships sponsored by various industrial organizations, foundations, and trust funds for the support of outstanding graduate students. These fellowships assist students in pursuing their studies and research full time. Most of these fellowships are restricted to specific areas of study, and interested students should contact the director of the school in which they plan to study.

Fellowships and loans that are not restricted to specific schools include the following.

Domenica Rea D'Onofrio Fellowship
The recipient, who must be from Italy, receives a stipend of up to $11,000 and a waiver/out-of-state tuition.

National Consortium for Graduate Degrees for Minorities in Engineering Fellowship
Candidates for participation in this program are selected from minorities (African-Americans, Puerto Ricans, American Indians, and Chicanos). In addition to the tuition, fees, and a stipend, this program provides an opportunity for summer work experience in one of several off-campus research laboratories. The GEM fellowship supports master's students in engineering and doctoral students in engineering or science. This application deadline is December 1. For further information, write to the College of Engineering, Georgia Institute of Technology, Atlanta, Georgia 30332-0360 or the GEM Center, P.O. Box 537, Notre Dame, Indiana 46556.

National Physical Science Consortium Graduate Fellowship (NPSC)
This Ph.D. fellowship offers up to six years of funding to U.S. citizens in astronomy, chemistry, computer science, geology, materials science, mathematical science, physics, and their sub disciplines. Students receive tuition, fees, a stipend, and two summers of employment with a private or government corporation doing research in the physical sciences and engineering. NPSC is open to all qualified applicants with a special emphasis on the recruitment of minorities and women. The application deadline is mid-November. For more information contact NPSC, c/o University of California, San Diego, 9500 Gilman Drive, La Jolla, CA 92093-0516.

Regents' Opportunity Scholarship
The recipients, who must be economically disadvantaged residents of Georgia, receive an award of $5,000 for the academic year. Awards are not available for summer term. Fellows are recommended by their major departments and selected by the Graduate Office.

United States Steel Foundation Loan Fund
This short-term loan fund is designated to assist graduate students in engineering, physics, chemistry, and mathematics and is administered by the Office of Student Financial Planning and Services.

Outside Sponsorships

A student whose tuition and fees are to be paid by a corporation or government sponsor must notify the Bursar's Office of the entity's billing address and the amount to be billed at least 60 days prior to the first fee payment deadline (Phase 1) of each semester. As a courtesy to students, the Bursar's Office will send a billing statement to the entity, but the student remains responsible for payment by the fee payment deadline should the sponsoring entity fail to complete payment by that date.

College of Architecture

WWW.ARCH.GATECH.EDU

College established in 1975, School in 1948, Department in 1908
Location: 247 4th Street, Atlanta, Georgia 30332-0155
Phone: (404) 894-4885/4886

Dean and Professor–Thomas D. Galloway; *Associate Dean and Professor*–Thomas N. Debo; *Professors*–Douglas C. Allen, William C. Bullock, Robert M. Craig, Dale A. Durfee, Charles Eastman, Steven P. French, James G. Johnson, Roozbeh Kangari, John A. Kelly, Joseph A. Koncelik, Ronald B. Lewcock, Richard J.L. Martin, Franklin K. Mooney, Arthur C. Nelson, Catherine L. Ross, David S. Sawicki, Jean D. Wineman; *Associate Professors*–Libero Andreotti, Godfried Augenbroe, Dominique Bonnamour-Lloyd, James Budd, Richard Dagenhart, Harris H. Dimitropoulos, Elizabeth M. Dowling, William J. Drummond, Garvin T. Dreger, Michael L.P. Elliott, George B. Johnston, Lorraine Justice, Edward L. Keating, Jude LeBlanc, Nancey Green Leigh, Kate Nesbitt, Lee Payne, John Peponis, H. Randal Roark, Saeid Sadri, Felix Uhlik, Craig M. Zimring; *Assistant Professors*–W.J. Blane, William Caldwell, Athanassios Economou, Lawrence D. Frank, T. Russell Gentry, Rita Gregory, Christopher Jarrett, Sabir Khan, Tahar Messadi, Charles Rudolph, William H. Russell, Anne S. Steinemann; *Instructors*–Mark Collins, Michael Gamble, Frederick M. Pearsall, Stuart M. Romm, Joseph de Casseres Reshower, Linda Thomas; *Research Engineers*-Scott Barr, Scott Haynes, Anatoliusz Lesniewski, Karen Milchus, R. Sivakumar; *Research Scientists*–Rand Bohrer, Sharon Bucci, William H. Buchman, Yan Z. Chen, Julius Daniel Corkran, William Curtis, Sarah Endicott, John Goldthwaite, Alan Harp, Renee Jacokes, Arthur Murphy, Hunter Ramseur, Zena Rubin, Robert Todd, Yi-Chang Tsai, Joanie Turner.

General Information

The College of Architecture offers three undergraduate programs (Architecture, Building Construction, Industrial Design) leading to the Bachelor of Science degree and graduate programs in architecture, city planning, and industrial design leading to the Master of Architecture, Master of City Planning, Master of Science, and Doctor of Philosophy degrees.

The original mission of the College, established as the Department of Architecture in 1908, was to prepare students for the professional practice of architecture. During the past 85 years, the mission of the College has expanded, both to provide continued leadership and to respond to changes in the professions and society. From its original focus on the practice of architecture, the College has become a multidisciplinary setting for teaching, research, and service at every scale of the constructed environment ranging from the design and production of the smallest utilitarian object to the planning and design of the city. The undergraduate programs of study and the graduate programs of study and research are fully described in the following sections.

All work executed in the College becomes the property of the College and will be retained or returned at the discretion of the faculty. The faculty also reserves the right to refuse for credit any project executed outside the precincts of the College or otherwise executed without proper coordination with the faculty.

Undergraduate Programs

The undergraduate program in architecture at Georgia Tech is a four-year, preprofessional program leading to the Bachelor of Science degree. It seeks to provide (1) a general university education in the liberal arts, fine arts, and technology; (2) multidisciplinary foundation in architectural studies with the design studio as a major focus of the curriculum; and (3) substantial opportunities for students to explore other disciplines, to concentrate studies in certificate programs, cluster electives, or dual degree programs. This Bachelor of Science program prepares students for graduate level studies in architecture, for graduate study in related fields, or a variety of career options related to architecture, the building industry, or government service.

In the United States, most state registration boards require a degree from an accredited professional degree program as a prerequisite for licensure. The National Architectural Accrediting Board (NAAB), which is the sole agency authorized to accredit U.S. professional degree programs in architecture, recognizes two types of degrees: the Bachelor of Architecture and the Master of Architecture. A program may be granted a five-year, three-year, or two-year term of accreditation, depending on its degree of conformance with established educational standards.

Master's degree programs may consist of a preprofessional undergraduate degree and a professional graduate degree, which, when earned sequentially, comprise an accredited professional education. However, the preprofessional degree is not, by itself, recognized as an accredited degree.

The NAAB grants candidacy status to new programs that have developed viable plans for achieving initial accreditation. Candidacy status indicates that a program should be accredited within six years of achieving candidacy, if its plan is properly implemented.

Grade Requirements

Students must maintain a minimum 2.0 grade average in each year grouping of architectural design studio courses (e.g., ARCH 2011, 2012, etc.) in order to enter the next sequence of studio courses. Each sequence of design studio courses must be started in the fall semester. A maximum of 9 credit hours may be taken on a pass/fail basis. Only courses taken as free electives within the undergraduate curriculum are eligible for pass/fail credit. See "Information for Undergraduate Students" for Institute regulations regarding pass/fail courses.

Students who complete both the bachelor's and master's degrees in architecture in the College may apply up to six credit hours of graduate course work for both degrees, subject to approval of the faculty and certain Institute regulations.

Bachelor of Science (Suggested Semester Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
COA 1011	FUNDAMENTALS OF DESIGN I	3
COA 1060	INTRODUCTION TO DESIGN	3
CS 1301	COMPUTER SCIENCE I	3
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
TOTAL SEMESTER HOURS		16

First Year - Spring Semester

Course Number/Name		*Hours*
COA 1012	FUNDAMENTALS OF DESIGN II	4
ENGL 1102	ENGLISH COMPOSITION II	3
HIST 2111 or 2112 or POL 1101	or PUBP 3000 or INTA 1200	3
MATH 1502	CALCULUS II	4
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		17

Second Year - Fall Semester

Course Number/Name		*Hours*
ARCH 2011	DESIGN STUDIO I	4
ARCH 2111	HISTORY OF ARCH I	3
ARCH 2211	CONSTRUCTION TECH. I	3
PHYS 2211	PHYSICS I	4
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		17

Second Year - Spring Semester

Course Number/Name		*Hours*
ARCH 2012	DESIGN STUDIO II	4
ARCH 2112	HISTORY OF ARCH II	3
PHYS 2212	PHYSICS II	4
HPS 1040/1061	WELLNESS	2
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		16

Third Year - Fall Semester

Course Number/Name		*Hours*
ARCH 3011	DESIGN STUDIO III	5
ARCH 3241	FUND. OF STRUCTURES	3
COLLEGE OF ARCHITECTURE ELECTIVES		3
FREE ELECTIVE		3
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		17

Third Year - Spring Semester

Course Number/Name		*Hours*
ARCH 3012	DESIGN STUDIO IV	5
ARCH 3231	ENVIRON.SYS. & DESIGN INT. I	3
HUMANITIES ELECTIVE		3
COLLEGE OF ARCHITECTURE ELECTIVE		3
FREE ELECTIVE		3
TOTAL SEMESTER HOURS		17

Fourth Year - Fall Semester

Course Number/Name	*Hours*
CLUSTER ELECTIVES	5
COLLEGE OF ARCHITECTURE ELECTIVES	9
FREE ELECTIVE	3
TOTAL SEMESTER HOURS	17

Fourth Year - Spring Semester

Course Number/Name	*Hours*
CLUSTER ELECTIVES	5
COLLEGE OF ARCHITECTURE ELECTIVE	3
FREE ELECTIVE	6
TOTAL SEMESTER HOURS	14

TOTAL PROGRAM HOURS = 129 SEMESTER HOURS PLUS WELLNESS (2 HRS)

Electives

Health and Performance Sciences Electives

Georgia Tech requires students to complete HPS 1040 or 1061 for the degree. Other health and performance science courses may count as free electives. No physical education course will count toward the degree.

Humanities Electives

Twelve credit hours of humanities courses are required. The required ENGL 1101 and 1102, and any other six credit hours of Institute-approved humanities courses, satisfy this requirement. ARCH 2111 and 2112 do not count toward this requirement for architecture majors.

Social Sciences Electives

Twelve credit hours of approved social sciences courses are required. To satisfy the state requirement regarding course work in the history and constitutions of the U.S. and Georgia, students must complete one of the following courses: HIST 2111, HIST 2112 , POL 1101, PUBP 3000, or INTA 1200. Either ARCH 4126 or HTS 3011 is also required. Any other six credit hours of Institute-approved social science courses will satisfy the remainder of this requirement.

Architectural Electives

Eighteen credit hours of approved College of Architecture electives are required. Courses chosen from the list of required courses for the M.Arch.I degree or any other courses taught in the College and not otherwise required will satisfy this requirement. The selection of any architecture elective should be made in consultation with the student's academic advisor.

Cluster Electives

A minimum of 10 credit hours in a concentrated cluster is required for the B.S. degree. Clusters may be made up from courses from within or outside of the College. This requirement may be fulfilled by several existing certificate programs on the campus, the senior year sequence of architectural design, or by a 10-hour concentration approved by the architecture faculty.

Free Electives

Fifteen credit hours of free electives are included in the curriculum to allow students to pursue architectural studies in additional depth or to pursue other educational interests within or outside the College. Courses chosen from the list of required courses for the M.Arch. degree or any other courses taught in the College or Institute and not otherwise required will satisfy this requirement.

The selection of these courses should be made in consultation with the student's advisor. Military training is an optional program of the Institute. A degree program may include a maximum of four hours of basic ROTC and a maximum of six hours of advanced ROTC. No course covering the same material as other courses may be applied for credit for the B.S. degree. MATH 1701 will not be counted toward any degree requirement.

Senior Year Study Abroad Program

Study in Paris

The College of Architecture conducts an annual Study Abroad Program in Paris, France, in association with the Ecole d'Architecture Paris-LaVillette. This program is designed to give qualified senior students in architecture the opportunity to complete all or part of their senior year in residence in Paris as part of a true cultural exchange. The year-long program offers courses taught by Georgia Tech faculty and native French faculty that parallel those courses taught in Atlanta while offering an international experience. Group field trips to significant French architectural and cultural sites and a jointly taught Franco-American studio broaden and enhance the program's cultural value. Opportunities also exist for individual study and travel. Due to the importance of communication skills in a successful exchange experience, students planning to participate in the Paris Study Abroad Program are required to complete a minimum of one year of French language courses well in advance of their senior year. Further details of the Paris Study Abroad Program are available in the *Undergraduate Architecture Student Handbook.*

Summer Study in Italy

The College's five-week summer program introduces students to Italian architecture, painting, and sculpture through instruction on site at museums, in historic buildings, and on walking tours through the city of Rome. During the five weeks, additional organized trips are taken to such sites as Venice, Florence, Tivoli, Ostia, or Siena. The curriculum requires 6 credit hours of humanities course work of all participants. A maximum of 12 credit hours of course work may be scheduled during the program, of which 6 may be in the form of independent study in areas such as visual communications. Graduate and undergraduate students from all majors are eligible for this program.

Building Construction

The construction industry is among the largest in the United States, employing more than 8 million people and contributing 8 percent of the U.S. gross national product. The Building Construction (BC) Program at the Georgia Institute of Technology is one of the leading programs in Building Construction in the nation. Our mission is to educate the leaders of tomorrow's construction industry in partnership with industry.

Employment prospects for BC students are excellent. Students are recruited by general contractors, residential home builders, project management firms, cost value and consulting firms, real estate and property development companies, building material suppliers, and local/state/federal government agencies. The average starting salary for the BC graduate is among the highest on the Georgia Tech campus and ranks at the top of the industry. The degree granted is a Bachelor of Science in Building Construction.

Students in the BC Program learn the basic principles and practices of construction management, real estate development, science, and technology. BC students are trained to manage the functions and processes of every aspect of the construction industry. The business climate in Atlanta is vibrant and provides an excellent laboratory opportunity for students to observe various construction sites and activities.The construction companies in the Atlanta area also provide many part-time jobs to students during their study in the BC Program.

Certificate Program in Building Construction

The Building Construction Program also offers the opportunity to the industry professional as well as students in all disciplines at Georgia Tech to broaden their building construction experience by granting recognition for study in building construction. The certificate program provides a course of study in the management and financial processes required to produce buildings in today's complex and dynamic industry. Industry professionals and students will acquire a working knowledge of the business of construction including the means and methods used to plan and manage the resources required in building delivery processes. The program should be particularly attractive to industry people and students in architecture, management, city planning, and the engineering disciplines.

The certificate requires a minimum of 12 semester hours of the following building construction courses at the 3000 and 4000 levels in which a grade of *C* or better must be earned. Participants must also satisfy the requirements for an undergraduate degree and be in good standing. Select four courses (12 hours) from the following list:

BC 3600	Construction Cost Mgmt.	3 hours
BC 3610	Construction Law	3 hours
BC 3620	Real Estate & Const. Finance	3 hours
BC 3630	Project Management I	3 hours
BC 4600	Project Managment II	3 hours
BC 4610	Value Eng. & Building Econ.	3 hours

Bachelor of Science in Building Construction (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
COA 1011	FUNDAMENTALS OF DESIGN I	3
COA 1060	INTRODUCTION TO DESIGN	3
CS 1301	COMPUTER SCIENCE I	3
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
TOTAL SEMESTER HOURS		16

First Year - Spring Semester

Course Number/Name		*Hours*
COA 1012	FUNDAMENTALS OF DESIGN II	4
ENGL 1102	ENGLISH COMPOSITION II	3
HIST 2111 or 2112 or POL 1101 or	PUBP 3000 or INTA 1200	3
MATH 1502	CALCULUS II	4
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		17

Second Year - Fall Semester

Course Number/Name		*Hours*
BC 2610	CONSTRUCTION TECH. I	3
BC 2630	CONSTRUCTION SEMINAR	1
ECON 2100	ECON. ANALYSIS & POLICY	3
ACCT 2101	ACCOUNTING I	3
PHYS 2211	PHYSICS I	4
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		17

Second Year - Spring Semester

Course Number/Name		*Hours*
BC 2600	CONSTRUCTION CONTRACTING	3
BC 2620	CONSTRUCTION TECH. II	3
MGT 2200	INFORMATION TECH.	3
EAS 1600	ENVIRONMENTAL FIELD SCIENCE	4
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS		15

Third Year - Fall Semester

Course Number/Name		*Hours*
BC 3600	CONSTRUCTION COST MGT.	3
BC 3630	PROJECT MANAGEMENT I	3
LCC 3XXX	HUMANITIES (COMMUNICATIONS)	3
PROFESSIONAL ELECTIVE		6
FREE ELECTIVE		3
TOTAL SEMESTER HOURS		18

Third Year - Spring Semester

Course Number/Name		*Hours*
BC 3610	CONSTRUCTION LAW	3
BC 3620	REAL ESTATE & CONST. FINANCE	3
MGT 3062	FINANCIAL MANAGEMENT	3
HUMANITIES ELECTIVE		3
FREE ELECTIVE		3
PROFESSIONAL ELECTIVE		3
TOTAL SEMESTER HOURS		18

Fourth Year - Fall Semester

Course Number/Name		*Hours*
BC 4620	BLDG. STRUCTURAL ANALYSIS	3
BC 4630	SENIOR PROJECT	3
PROFESSIONAL ELECTIVES		6
FREE ELECTIVE		3
TOTAL SEMESTER HOURS		15

Fourth Year - Spring Semester

Course Number/Name		*Hours*
BC 4600	PROJECT MANAGEMENT II	3
BC 4610	VALUE ENG. & BLDG. ECONOMICS	3
PROFESSIONAL ELECTIVES		6
FREE ELECTIVE		3
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 129 SEMESTER HOURS PLUS WELLNESS (2 HRS)

Electives

Free Electives
Twelve semester hours of free electives are required. Military training is an option allowed by the Institute. If basic ROTC is elected, six credit hours of free electives may be used. If advanced military training is elected, nine credit hours of professional hours for this purpose will be credited toward meeting degree requirements.

The College of Architecture will accept only the two required hours of physical education toward meeting degree requirements.

Professional Electives
Eighteen semester hours of professional electives are required at the 3000 level or above; these courses should be selected from the list of Recommended Professional Electives provided by the BC Program. Three hours of professional elective credit may be satisfied on a pass/fail basis for summer intern employment in the construction industry with departmental consent and approval. The Building Construction professional electives provide students the opportunity to pursue specialized study and develop skills in: Construction Management, Construction Development, and Construction Science. Construction Management prepares students for managerial systems and practices utilized by constructors to manage the planning and delivery processes of buildings in the contemporary practice of construction. Managerial areas of study range from internal management systems used by general contractors and builders in office operations and practice to management and systems controls employed by construction managers in the planning, design, and construction phases of complex building projects. Construction Development introduces students to entrepreneurial theories and practices used in the development of construction projects ranging from single facilities to multiple building complexes. It focuses on urban economic theories, planning legislation and regulation, and urban development methods applicable in land and real estate investment. Emphasis is on the development and marketing theories of building projects in the context of contemporary planning and urban development issues. Construction Science is an analytically and engineering-oriented study designed to encourage students to challenge current methods of building construction and delivery techniques and to seek innovative solutions through study, research, and technical inquiry. Emphasis is on the means and methods of constructing buildings, the intrinsic nature and use of construction materials, the anatomy of building systems and components, and prefabricated building systems and components development and production concepts.

Humanities and Social Sciences Electives
Three semester hours of humanities are required. Nine semester hours of social sciences are required. To satisfy the state requirements regarding coursework in the history and constitutions of the U.S. and Georgia, students must complete one of the following courses: HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200. See the approved list of Humanities and Social Sciences courses in this catalog.

City Planning
The City Planning Program offers no undergraduate degrees. However, a number of undergraduate courses are offered each semester. In addition, three planning courses are available for social sciences credit: CP 4010 - Foundations of Urban and Regional Development; CP 4020 - Introduction to Urban and Regional Planning; and CP 4030 - The City and Its Technology. CP 4040 - The City in Fiction and Film is available for humanities credit.

An accelerated program is available to Tech undergraduate students wishing to pursue the master's degree in city planning simultaneously with their undergraduate degree. See details in the graduate section on City Planning.

Industrial Design
Industrial design is the professional service of creating and developing concepts and specifications that optimize the function, value, and appearance of products and systems for the mutual benefit of both user and manufacturer. Industrial designers, with their wide range of interests and generalist outlook in an age of specialization, must be part artist, part entrepreneur, and part engineer.

The industrial designer's work touches all of our lives in the form of home furnishings, transportation, appliances, recreational equipment, and a myriad of other consumer and industrial products and services. While giving form to the efforts of industry, the designer is at the same time a consumer advocate, providing the humanizing link between technology and the consumer.

The Georgia Tech program offers a well rounded course of study with early emphasis on basic design and design skills. Design projects stress realistic design situations. The program encourages students to develop a diverse background in order to expand individual talents and respond to changing opportunities in the field. Most faculty members are practicing designers with extensive experience in the field. All work executed in the College becomes the property of the College and will be retained or returned at the discretion of the faculty. The faculty also reserves the right to refuse credit for any project executed outside the precincts of the College or otherwise executed without proper coordination with the instructor.

Grade Requirements

All industrial design courses must be completed with a grade of *C* or higher. A student may not enter a more advanced design course until this requirement is met; students with such academic deficiencies may be required to delay their studies for one year. Studio design courses must be taken in sequence beginning fall semester. Transfer students from other Georgia Tech programs must have a cumulative minimum grade point average of 2.8. Students already enrolled at Georgia Tech must have a cumulative minimum grade point average of 2.8. Students interested in transferring from another school should contact the Georgia Tech Office of Undergraduate Admission. A maximum of 9 credit hours may be taken on a pass/fail basis. Only courses taken as free electives in the undergraduate curriculum must be taken for pass/fail credit. See "Information for Undergraduate Students" for Institute regulations regarding pass/fail courses.

Bachelor of Science in Industrial Design (Suggested Semester Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
COA 1011	FUNDAMENTALS OF DESIGN I	3
COA 1060	INTRODUCTION TO DESIGN	3
CS 1301	COMPUTER SCIENCE I	3
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
TOTAL SEMESTER HOURS		16

First Year - Spring Semester

Course Number/Name		*Hours*
COA 1012	FUNDAMENTALS OF DESIGN II	4
ENGL 1102	ENGLISH COMPOSITION II	3
HIST 2111 or 2112 or POL 1101 or	PUBP 3000 or INTA 1200	3
HPS 1040/1061	WELLNESS	2
MATH 1502	CALCULUS II	4
TOTAL SEMESTER HOURS		16

Second Year - Fall Semester

Course Number/Name		*Hours*
ID 2011	INTRO. TO ID I	4
ID 2201	ISSUES FOR DESIGN	3
COA 2241	ART HISTORY I	3
SOCIAL SCIENCE ELECTIVE		3
PHYS 2211	PHYSICS I	4
TOTAL SEMESTER HOURS		17

Second Year - Spring Semester

Course Number/Name		*Hours*
ID 2012	INTRO. TO I.D. II	4
ID 2202	HISTORY OF MODERN I.D.	3
COA 2242	ART HISTORY II	3
LCC 3400	TECHNICAL COMMUNICATIONS	1
PHYS 2212	PHYSICS II	4
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		18

Third Year - Fall Semester

Course Number/Name		*Hours*
ID 3011	INTERMEDIATE I.D. I	5
ID 3301	MATERIALS/PROCESSES I	3
INDUSTRIAL DESIGN ELECTIVE		3
SOCIAL SCIENCE ELECTIVE		3
FREE ELECTIVE		3
TOTAL SEMESTER HOURS		17

Third Year - Spring Semester

Course Number/Name		*Hours*
ID 3012	INTERMEDIATE I.D. II	5
ID 3302	MATERIALS/PROCESSES II	3
INDUSTRIAL DESIGN ELECTIVE		3
SOCIAL SCIENCE ELECTIVE		3
FREE ELECTIVE		3
TOTAL SEMESTER HOURS		17

Fourth Year - Fall Semester

Course Number/Name		*Hours*
ID 4011	ADVANCED I.D. I	5
ID 4201	DESIGN/RESEARCH METHODS	3
COA HISTORY ELECTIVE		3
FREE ELECTIVE		5
TOTAL SEMESTER HOURS		16

Fourth Year - Spring Semester

Course Number/Name		*Hours*
ID 4012	ADVANCED I.D. II	5
ID 4202	PROFESSIONAL PRACTICE	3
ID 4204	THEORIZING DESIGN	3
FREE ELECTIVE		3
TOTAL SEMESTER HOURS		t4

TOTAL PROGRAM HOURS = 129 SEMESTER HOURS PLUS WELLNESS (2 HRS)

Electives

Humanities Electives

Twelve credit hours of humanities courses are required. The required ENGL 1101, 1102, and COA 2241 and 2242 satisfy this requirement. ID 2202 does not count toward this requirement for industrial design majors.

Social Sciences Electives

Twelve credit hours of approved social sciences courses are required. To satisfy the state requirements regarding course work in the history and constitutions of the U.S. and Georgia, students must complete one of the following courses: HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200. Any other nine credit hours of Institute-approved social science courses will satisfy the remainder of this requirement.

Health and Performance Sciences Electives

Georgia Tech requires students to complete HPS 1040 or 1061 for the degree. Other health and performance science courses may count as free electives. No physical education course will count toward the degree.

General and Industrial Design Electives

Fourteen general elective hours are required. The general elective hours may include six hours of credit for ROTC courses. Those enrolling in ROTC must schedule appropriate ROTC courses in the freshman and sophomore years.

Students are encouraged to use general electives to fulfill one of several track elective options. Contact the industrial design program office for approved tracks.

Only nine hours of electives taken on a pass/fail basis may be applied toward fulfilling requirements for the B.S.I.D. degree.

Nine industrial design elective hours are required.

Track Electives

Students are encouraged to use general electives to fulfill one of several track elective options. Contact the industrial design program office for approved tracks.

Graduate Programs

Architecture

The master's program in architecture at Georgia Tech is dedicated to the development of knowledge in the field of architecture through excellence in professional education; through creative and scholarly research and practice; and through devoted public service. The master's program is especially committed to the future of both the discipline and profession of architecture through preparation of its future leaders.

The general emphasis of graduate study in architecture is on three inter-related concerns:

1.) The program is committed to the architecture of the city and to the solution of urban problems through direct engagement with Atlanta and other environs as working design laboratories.

2.) While emphasizing design, the program also stresses the responsibilities of form and encourages an appreciation of architecture as constructed artifact that must accommodate and integrate human, technological, and environmental requirements.

3.) The program encourages the critical exploration of representational means in design ranging from traditional techniques to electronic media for purposes of both speculation about and production of architecture.

The graduate curriculum addresses this range of professional and scholarly concerns through offerings in six areas of both required and elective course work. These areas include:

a) architectural design;
b) history and theory;
c) technology;
d) architecture, culture, and behavior;
e) professional practice; and
f) visual communication and representation.

Three graduate degree options are offered within the Architecture Program: the M.Arch.I Program, the M.Arch.II Program, and the M.S. Program. Each degree option includes specific admission and academic requirements leading to the award of the first professional degree, the second professional degree, or the non-professional degree in architecture, respectively.

Master of Architecture (M.Arch.I)

The M.Arch.I Program, leading to the Master of Architecture as the first professional degree, is oriented toward the professional practice of architecture and is fully accredited by the National Architectural Accrediting Board (NAAB). This degree option provides flexibility for students who have an undergraduate degree with a major in architecture as well as those who have a degree in a field other than architecture. The M.Arch.I Program requires a minimum of 60 credit hours and a maximum of 108 credit hours of study, depending upon the applicant's prior education in architecture and the amount of advanced standing credit granted upon admission to the program. Normally, a student admitted to the program with maximum advanced standing can expect to complete the program within two academic years of full-time study. A student admitted to the program with no advanced standing can expect the program to require three and one-half academic years of full-time study. Graduates from a four-year undergraduate program in architecture similar to that at Georgia Tech can normally expect to complete the program in two academic years, if they have pursued architecturally related elective course work during their undergraduate years. In all cases, the Master's Project, or the optional Master's Thesis, is required for award of the Master of Architecture degree. Specific information regarding applications for advanced standing and degree requirements is available from the Architecture Program.

The minimum requirements for the M.Arch.I degree, for a student with a previous degree in architecture, are as follows:

Architectural Design Studios	15 credit hours
Professional Core Requirements	15 credit hours
Master's Project/Thesis Option	9 credit hours
Approved Professional Electives	21 credit hours
TOTAL (Minimum)	60 credit hours

Total Minimum Required Credit Hours for M.Arch. I. Program = 60

The maximum requirements for the M.Arch.I degree, for a student with a previous degree in a discipline other than architecture, are as follows:

Architectural Design Studios	30 credit hours
Preparatory Requirements	18 credit hours
Professional Core Requirements	30 credit hours
Master's Project/Thesis Option	9 credit hours
Approved Professional Electives	21 credit hours
TOTAL (Maximum)	108 credit hours

Total Maximum Required Credit Hours for M.Arch.I Program = 108

Master of Architecture (M.Arch.II)

The M.Arch.II Program is a postprofessional degree in architecture and has the primary purpose of providing advanced studies in architecture and urban design, with an emphasis on the studio. A previous professional degree in architecture is required (B.Arch. or M.Arch.) prior to entry into the program. The minimum length of study is one academic year. The minimum requirements are as follows:

Core Course	3 credit hours
Architectural Design Studios	5 credit hours
Architecture Electives or Thesis	9 credit hours
Free Electives	13 credit hours
TOTAL	30 credit hours

Total Minimum Required Credit Hours for the M.Arch.II Program = 30

Master of Science (MS)
The MS program is a non-professional program in advanced architectural and industrial design studies and is oriented toward scholarship and research. Applicants may have previous degrees in architecture or other related fields. The areas of specialized study include a) history and theory of architecture; b) urban design; c) architectural technology and building science; d) architecture, culture, and behavior; e) computing and information technologies in architecture; and f) industrial design study options. In addition, faculty interests support a wide range of other interests and study areas.

Multidisciplinary Study
Multidisciplinary studies are strongly encouraged in all of the master's programs in architecture. These studies may be part of formal dual degree programs, including architecture and city planning, architecture and civil engineering, architecture and management, etc. Other multidisciplinary studies are possible within the College of Architecture, the Institute, and at Emory University, Georgia State University, and the Atlanta College of Art among other Atlanta area colleges and universities. Course work outside the architecture program frequently includes city planning, public policy, history, philosophy, real estate development, engineering, and studio art.

Foreign Study Programs
Graduate students in architecture are eligible to participate in two foreign study programs. The first is the Summer Program in Europe, which has a primary focus on modern and contemporary architecture in Paris, Berlin, and Holland. The second is the Summer Study in Italy Program, which focuses on architecture, painting, and sculpture at a variety of sites in Italy. For more information, refer to "Summer Study in Italy."

Applications
The deadline for applications is January 15 for the following fall semester. Each applicant must have an outstanding undergraduate record and must submit a portfolio of creative work. The Graduate Record Examination is required for all applicants. A minimum TOEFL score of 550 (paper-based) or 213 (computer-based) is required for all foreign applicants. All applicants should be aware that the Master's Program in Architecture has specific application requirements; therefore, all applicants should request a complete application package and instructions by calling (404) 894-4885, faxing to (404) 894-0572, or writing to Architecture Program Graduate Admissions, College of Architecture, Georgia Institute of Technology, Atlanta, GA 30332-0155.

City Planning
Founded in 1951, Tech's planning program is one of the oldest professional planning programs in the United States, with nearly 900 alumni. Graduates are employed in both the public and private sectors, at all levels of government, by banks, real estate development companies, public utilities, and private corporations. The program is accredited by the Planning Accreditation Board; it is the only accredited planning program in Georgia.

The city planning program offers course work in seven major areas of urban and regional planning: land development, environmental planning, transportation, economic development, geographic information systems, urban design, and land use policy. Several types of programs of study are available: the professional Master of City Planning; joint degrees with civil and environmental engineering, architecture, and other Tech programs; and a five-year B.S./M.C.P. degree. Descriptions of each follow.

Master of City Planning Degree
This program educates the student whose career goal is to be a professional planner. The program requires 56 total credit units for graduation. Approximately half of the program consists of required courses, called the core. The core is composed of three substantive streams: planning theory and process, including planning law, institutional analysis, plan implementation, and history and theory of planning; planning methods, including data analysis, computer applications, descriptive and inferential statistics, microeconomic analytic techniques and planning information systems; and urban and regional theory, which explores the structure and function of urban systems. The core is largely contained within the student's first two semesters. Students must choose one of the seven areas of concentration described above. Each specialization consists of at least four courses.

The two-year curriculum requires, for most students, four semesters of course work, including a four-credit applied research paper. Some students choose to write a full 10-credit hour thesis. A salaried approved internship is required for those students with no previous planning work experience.

The Graduate Record Examination is required for all applicants to the Master of City Planning program. A minimum TOEFL score of 600 is required for all foreign applicants. Since the course material is sequential in nature, fall matriculation is strongly recommended. Applications must be completed before March 1 to ensure consideration for financial aid.

The Joint Degree

The city planning program maintains joint degree programs with several other academic units at Georgia Tech: urban design in architecture and transportation and water resources in civil and environmental engineering. The concept behind the joint degree program is that a student can structure his or her program so that required courses taken in one program can serve as elective credit in the other, thus allowing the student to receive two master's degrees in less time than the two would take to complete if pursued separately. Candidates seeking the joint degree should state their intentions and be officially admitted into city planning and simultaneously accepted internally by the second program. In addition to the joint degree programs, the business administration program in real estate at Georgia State University offers a certificate in real estate that some planning students elect to pursue; likewise, the history program at Georgia State University offers a historic preservation certificate.

The Five-Year B.S./M.C.P. Degree

Undergraduates may work simultaneously on their bachelor's degree and a master's in planning. By enrolling in all required planning classes as electives for the baccalaureate degree, students may obtain both an undergraduate degree as well as complete course work toward a graduate degree. Students should request and receive permission from the director of the planning program to begin their program of study in planning no later than fall of their junior year. Students with cumulative GPAs above 3.0 will be automatically approved. With proper scheduling, students can complete the two-year master's program in one year beyond the usual bachelor's degree. The key is to carefully schedule the program of study early in the undergraduate program. This program is particularly appropriate for architecture, management, economics, civil and environmental engineering, and earth and atmospheric science majors.

Doctoral Program

The program leading to the Doctor of Philosophy degree in the College of Architecture has been developed to enable students of exceptional ability to undertake advanced study and original research in the fields of architecture and planning. Currently the program includes several fields of study: 1) city and regional planning; 2) architecture, culture, and behavior; 3) architectural history, theory, and criticism; 4) building technology; 5) design computing; and 6) building construction.

Several areas of city and regional planning studies are available for dissertation research: studies of land use planning, economic development, land and housing economics, urban and regional development, information systems, transportation planning, and environmental planning. Students in the Architecture, Culture, and Behavior field pursue studies of human responses to the design of buildings and urban space, including morphological studies, studies of environmental perception and cognition, facilities programming, and evaluation. The Architectural History, Theory, and Criticism field addresses the following: architectural history, philosophy, criticism and practice, including design philosophies, methods, and criticism; it also allows study of preservation and conservation focusing on technical and methodological issues in the preservation of historical and contemporary building components, buildings, and cities. Studies in Building Technology are concerned with the interface between technology and design construction, including the development and application of advanced knowledge in materials, construction processes, industrial systems, and environmental factors. Design Computing focuses on the development of information technologies in support of creative design and building. Current areas of research include parametric geometric modeling, design databases and electronic design environments, building models, direct fabrication of designs (building CAD/CAM), and visualization. Research in the field of building construction is focused on management and environmental aspects of construction. Current research areas are risk management, robotics and automation in building construction, indoor air, design-build, construction development and management, life cycle cost management, and integrated facility management.

For further details on the program, contact the Director of the Doctoral Program, College of Architecture, Georgia Institute of Technology, Atlanta, Georgia 30332-0155.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

ARCHITECTURE

ARCH 2011. Architectural Design Studio I
0-12-4. Prerequisite(s): COA 1012
Elementary design exercises exploring fundamental issues of form and space through analysis of architectural elements and compositions and their use in creative problem solving.

ARCH 2012. Architectural Design Studio II
0-12-4. Prerequisite(s): ARCH 2011
Elementary design exercises focusing upon the compositional integration of building and site through the creative assimilation of programmatic, technical, and contextual requirements.

ARCH 2111. History of Architecture I
3-0-3.
Architectural history from antiquity through the 18th century emphasizing buildings in their cultural context as informed by social, technological, and constructive factors and theoretical positions.

ARCH 2112. History of Architecture II
3-0-3. Prerequisite(s): ARCH 2111
Architectural history during the 19th and 20th centuries emphasizing buildings in their cultural context as informed by social, technological, and constructive factors and theoretical positions.

ARCH 2211. Construction Technology and Design Integration I
3-0-3.
Introduction to building anatomy, technical and expressive characteristics of materials and their organizational assembly.

ARCH 3011. Architectural Design Studio III
1-12-5. Prerequisite(s): ARCH 2012
Intermediate architectural design projects emphasizing the functional priorities and expressive potential of building technologies through studio problems of varying programmatic and contextual complexity.

ARCH 3012. Architectural Design Studio IV
1-12-5. Prerequisite(s): ARCH 3011
Intermediate architectural design projects exploring the interrelationships of various programmatic models, normative building types, and technological themes within specific physical, urban, and cultural contexts.

ARCH 3231. Environmental Systems and Design Integration I
3-0-3. Prerequisite(s): ARCH 2211
Human physiology, the occupation of space, and principles of sustainability. Micro-climate, energy consumption, thermal loading, passive solar strategies, daylighting, optics, and accoustics.

ARCH 3241. Fundamentals of Structures
2-3-3. Prerequisite(s): PHYS 2212
Physics of structure: principles of statics, strengths of materials, and the dynamic forces acting upon them.

ARCH 4011. Architectural Design Studio V
1-12-5. Prerequisite(s): ARCH 3012
Advanced studies in architectural design emphasizing application of analytical, conceptual, and representational skills within projects that engage and problematize urban contexts culturally, ecologically, and technologically.

ARCH 4012. Architectural Design Studio VI
1-12-5. Prerequisite(s): ARCH 4011
Advanced studies in architectural design emphasizing application of analytical, conceptual, and representational skills within projects that engage and problematize urban context culturally, ecologically, and technologically.

ARCH 4021. Architecture Core Studio I
1-12-5.
Foundation studies in architectural design emphasizing analytical and analogical generative strategies applied to studio problems that engage architectural representation, composition, and fabrication.

ARCH 4022. Architecture Core Studio II
1-12-5. Prerequisite(s): ARCH 4021
Intermediate studies in architectural design emphasizing integrative design strategies that engage the programmatic, contextual, and constructed dimensions of architecture and its representations.

ARCH 4023. Architecture Core Studio III
1-12-5. Prerequisite(s): ARCH 4022
Advanced studies in architectural design emphasizing the interrelationship of architectural and urban history, theory, and practice through studio problems that engage all aspects of architectural design.

ARCH 4105. History of Architecture I
3-0-3.
Architectural history from antiquity through the 18th century emphasizing buildings in their cultural context as informed by social, technological, and constructive factors and theoretical positions.

ARCH 4106. History of Architecture II
3-0-3. Prerequisite(s): ARCH 4105
Architectural history during the 19th and 20th centuries emphasizing buildings in their cultural context as informed by social, technological, and constructive factors and theoretical positions.

ARCH 4113. History of Renaissance and Mannerist Architecture
3-0-3. Prerequisite(s): ARCH 2111 or ARCH 4105
Investigation of the history and theory of Renaissance and Mannerist architecture with a primary emphasis on Italy.

ARCH 4114. Medieval Architecture
3-0-3. Prerequisite(s): ARCH 2111 or ARCH 4105
Investigations of the architecture of Medieval Europe with an emphasis on English and French Romanesque and Gothic, including towns and castles.

ARCH 4117. Architecture and the Arts and Crafts Movement
3-0-3. Prerequisite(s): ARCH 2111 or ARCH 4105
Investigations in the theory, design, and building methods of English and American architects associated with the Arts and Crafts Movement.

ARCH 4118. American Academic Architecture
3-0-3. Prerequisite(s): ARCH 2112 or ARCH 4106
Investigations of the history and theory of late 19th and 20th century classicism in America.

ARCH 4119. Architecture of Frank Lloyd Wright
3-0-3. Prerequisite(s): ARCH 2112 or ARCH 4106
Investigations on the life and work of Frank Lloyd Wright.

ARCH 4120. Atlanta Architecture
3-0-3. Prerequisite(s): ARCH 2112 or ARCH 4106
Investigations through lectures, reading, and research of the history of Atlanta architecture and significant architectural firms from the city's founding to the present.

ARCH 4123. European Modernism
3-0-3. Prerequisite(s): ARCH 2112 or ARCH 4106
Survey of European architecture from Art Nouveau to LeCorbusier.

ARCH 4124. History of Architecture in the United States
3-0-3. Prerequisite(s): ARCH 2111 or ARCH 4105
History investigations of architecture within the continental United States from the colonial period to the present.

ARCH 4125. French Architecture from Ledoux to LeCorbusier
3-0-3. Prerequisite(s): ARCH 2112
History of French architecture form Ledoux to LeCorbusier with special emphasis on Paris.

ARCH 4126. Paris Urban History
3-0-3. Prerequisite: ARCH 2112
The social, cultural, urban, and architectural history of the city of Paris from its founding until the present. Course offered in Paris only.

ARCH 4151. History of Urban Form
3-0-3. Prerequisite(s): ARCH 2111 or ARCH 4105
History of the city as a collective work of architecture with an emphasis on the city's physical form and space.

ARCH 4219. Construction Technology and Design Integration I
3-0-3.
Introduction to building anatomy, technical and expressive characteristics of materials and their organizational assembly.

ARCH 4220. Construction Technology and Design Integration II
1-6-3. Prerequisite(s): ARCH 2211 or ARCH 4219
Integration, representation, and constructability of building assemblies and structural systems. Grading, drainage, foundations, structure, and enclosure in relation to building codes and principles of sustainability.

ARCH 4231. Environmental Systems and Design Integration II
3-0-3. Prerequisite(s): ARCH 3231
Active building systems design: artificial lighting, mechanical, electrical, communication, transportation systems. Case studies of integrated and sustainable building assemblies.

ARCH 4251. Architectural Structures and Design Integration I
2-3-3. Prerequisite(s): ARCH 3241
Analysis and design of short span structures emphasizing wood and masonry. Structural properties of building enclosure, foundation types, and bearing properties of soil.

ARCH 4252. Architectural Structures and Design Integration II
2-3-3. Prerequisite(s): ARCH 4151
Analysis and design of long-span structures emphasizing steel, timber, and reinforced concrete. Structural properties of building enclosure, foundation types, and bearing properties of soil.

ARCH 4253. Advanced Structures Seminar
3-0-3. Prerequisite(s): ARCH 4252
Fundamentals of steel and concrete design and the computerized design of steel and concrete structural systems for multi-story buildings.

ARCH 4303. Programming and Building Evaluation
3-0-3.
Building programming and evaluation of building performance with respect to the aims of organizational users, policy development, and the process of planning and design decisions.

ARCH 4315. Professional Practice of Architecture
3-0-3.
Principles and framework of professional practice including ethics, legal climate, business practices and contracts, project process and management, office organization, and methods of building production.

ARCH 4316. Traditions of Architectural Practice
3-0-3. Prerequisite(s): ARCH 2112 and ARCH 4106
Critical examination of architectural practice. Cultural derivation and technological transformation of various conventions of representation, construction, and design; speculation about future paradigms of architectural practice.

ARCH 4330. Understanding Clients and Users: Methods for Programming and Evaluation
3-0-3.
Theories and methods of architectural programming and evaluation.

ARCH 4334. Housing and Culture
3-0-3.
Examination of social, cultural, and behavioral issues as they influence the form of houses and housing.

ARCH 4335. The Social Practice of Architecture
3-0-3.
Introduction to theories and findings about human use and experience of Architecture.

ARCH 4411. Introduction to Visual Arts
1-6-3.
Orientation to issues of visual perception and representation of form and space through freehand drawing, composition, color, texture, mixed-media, and journal making.

ARCH 4412. Drawing and the Human Figure
0-9-3. Prerequisite(s): ARCH 4411
Studio instruction in figure drawing from the live model with emphasis on the structure and dynamics of the human figure.

ARCH 4413. Collage Making
1-6-3. Prerequisite(s): ARCH 4411
Concepts of collage within art, architecture, and culture; manual and electronic approaches to two- and three-dimensional collage making.

ARCH 4414. Representation in Watercolor
1-6-3. Prerequisite(s): ARCH 4411
Introductory course in the use of transparent watercolor for field painting and architectural representation. Theory of pigment characteristics in applied painting.

ARCH 4415. Photography I
1-6-3.
Introduction to studio, darkroom, and field photography with emphasis on composition, processing, and printing.

ARCH 4416. Photography II
1-6-3. Prerequisite(s): ARCH 4415
Advanced techniques in photography. Use of color, filters, four-by-five format cameras with emphasis on architectural photography.

ARCH 4420. Introduction to Design Computing
2-3-3.
Survey of computer representations and modeling techniques, including pixel-based images, vector-based drawing systems, and surface and solid modeling; use of applications built upon these systems.

ARCH 4770. Psychology aand Environmental Design
2-3-3.
Introduction to psychological concepts relevant to environmental design. Survey of selected methods for assessing human-made environments. Crosslisted with PSYC 4770.

ARCH 4801-2-3-4-5. Special Topics
Credit hours equal the last digit in the course number.

ARCH 4811. Special Topics: Architectural Design
0-3-1.

ARCH 4812. Special Topics: Architectural Design
0-6-2.

ARCH 4813. Special Topics: Architectural Design
0-9-3.

ARCH 4814. Special Topics: Architectural Design
0-12-4.

ARCH 4815. Special Topics: Architectural Design
0-15-5.

ARCH 4821-2-3. Special Topics: History, Theory, and Criticism
3-0-3, each.

ARCH 4831-2-3. Special Topics: Architectural Technology
3-0-3, each.

ARCH 4841-2-3. Special Topics: Professional and Social Practice
3-0-3, each.

ARCH 4851. Special Topics: Visual Arts and Computing
0-3-1.

ARCH 4852. Special Topics: Visual Arts and Computing
0-6-2.

ARCH 4853. Special Topics: Visual Arts and Computing
0-9-3.

ARCH 4901-2-3-4-5. Special Problems
Credit hours to be arranged

ARCH 4911-2-3-4-5. Special Problems: Architectural Design
Credit hours to be arranged

ARCH 4921-2-3. Special Problems: History, Theory, and Criticism
Credit hours to be arranged

ARCH 4931-2-3. Special Problems: Architectural Technology
Credit hours to be arranged

ARCH 4941-2-3. Special Problems: Professional and Social Practice
Credit hours to be arranged

ARCH 4951-2-3. Special Problems: Visual Arts and Design Computing
Credit hours to be arranged

ARCH 6031-2-3. Architecture Options Studio I, II, III
1-12-5, each.
Advanced studio problems in architecture emphasizing research and application in the areas of history and theory, urban and environmental design, culture and practice, electronic media, and construction technology.

ARCH 6111. Theories of Ornament
3-0-3. Prerequisite(s): ARCH 2112 and ARCH 4106
Study of the aesthetics of the surface in architecture through inquiry of current and historic theories and buildings.

ARCH 6112. Islamic and Indian Architecture and Urbanism
3-0-3.
Two-part survey of Asian architecture and urbanism (excluding East Asia). The Islamic world up to the 18th century: the Mughal, Raj, and post-independence periods in Indian subcontinent.

ARCH 6131. Architectural Theory and Criticism I
3-0-3 each. Prerequisite: ARCH 4106
Critical study of theoretical writings and architectural production prior to the 20th century.

ARCH 6132. Architectural Theory and Criticism II
3-0-3 each. Prerequisite: ARCH 4106
Critical study of theoretical writings and architectural production of the 20th century to the present.

ARCH 6133. The Artistic and Architectural Avant-Gardes
3-0-3.
Avant-garde influences on architectural thought and production within Modernity and Post-modernity.

ARCH 6134. Language of the City
3-0-3.
Representations and cultural significance of the city in film, the arts, and literature.

ARCH 6135. Architectural Representation
3-0-3.
Systems of architectural representation and codes of thinking, drawing, and reading architecture.

ARCH 6136. Architecture and Ideology
3-0-3.
Architecture and politics in Italy, Germany, and the Soviet Union between the wars.

ARCH 6151. Theories of Urban Design
3-0-3.
Contemporary theories of urban design and their relationship to the contemporary city examined through architects' writings, urban projects, and interdisciplinary criticism.

ARCH 6152. Studies in Landscape Architecture
3-0-3.
History and theory of the designed landscape and garden from the ancient world to the present.

ARCH 6153. History and Theory of the Modern City
3-0-3.
An examination of the evolution of the modern city in the 19th and 20th centuries with particular reference to architectural, city planning, and urban design theories.

ARCH 6154. Introduction to Urban Design
3-0-3.
Introduction of urban design ideas, research, and practice examining traditional qualities of the American city and their possible applications in the contemporary city.

ARCH 6206. Studies in Architectural Building Assemblies
3-0-3. Prerequisite(s): ARCH 4219
Structural and cladding systems integration, environmental control, and tectonic representation explored through historical and contemporary case studies and applied design solutions.

ARCH 6207. Constructability and Form: Necessity, Possibilities, and Dissociations
3-0-3.
Beyond idealized concepts of materiality and tectonics, actual conditions of construction influence design. Links between construction methods, materials, and forms are posited within a larger tectonic context.

ARCH 6208. Design and Technology of the American Skyscraper
3-0-3.
The study of the evolution, style, and technology of the skyscraper and its role in the creation of public space in the city.

ARCH 6209. Building Enclosure: A Tectonic Element
3-0-3.
Investigations of enclosure design from three perspectives (technology, form, and culture), analyzing relationships of the four Semperian elements and Alberti's three parts of the enclosure.

ARCH 6215. Contemporary Architecture and Construction Technology
3-0-3.
General exposure to questions pertaining to the production of building systems and assemblies through a series of case study projects by contemporary practicing architects.

ARCH 6216. Eco-Technology: Ideas and Constructions
3-0-3. Prerequisite(s): ARCH 3231 and ARCH 4231
Strategies of ecologically sustainable design and construction and the role of the architect in the stewardship of the environment.

ARCH 6217. Constructive Arts Workshops
2-3-3. Prerequisite(s): ARCH 4219
Exploratory construction drawing, qualities and performance of materials and their joinery, explored through a synthetic process of detailing and full-scale fabrication of artifacts.

ARCH 6218. The Material Logic of Architecture
2-3-3. Prerequisite(s): ARCH 3241
Introduction to scientific and practical nature of architectural materials: soils, cements, metals, plastics, and glazing materials. Laboratory includes fabrication of, and experiments on, architectural materials.

ARCH 6231. Residential Building Thermal Design and Simulation
3-0-3. Prerequisite(s): ARCH 4231 and ARCH 4232
Manual and computer-aided thermal design and analysis with emphasis on residential buildings.

ARCH 6232. Commercial Building Thermal Design and Simulation
3-0-3. Prerequisite(s): ARCH 4231 and ARCH 4232
Manual and computer-aided thermal design and analysis with emphasis upon commercial buildings.

ARCH 6312. Ecological Practice: History, Polemics, and Poetics
3-0-3.
A historically and culturally grounded examination of the ecological perspective. Critical and productive engagement with green guidelines, laws, products, design briefs, and procedures.

ARCH 6331. Space and Culture of Institutional Buildings
3-0-3.
Application of theories of social and cultural function to considerations of spatial layout and design of a particular institutional building type.

ARCH 6404. Electronic Media: From Technique to Culture
3-0-3.
The influence of electronic media upon representation and invention in architecture.

ARCH 6424. Intelligent Computer-Aided Architectural Design
1-6-3. Prerequisite(s): ARCH 4420
Use and evaluation of advanced CAD packages for use in architecture; multiple application packages will be addressed.

ARCH 6425. Electronic Design Conceptualization and Development
1-6-3. Prerequisite(s): ARCH 6421
Advanced-level CAD approaches to early design conceptualization and development in electronic media; emphasis on 3D modeling and evolving abstract design concepts into architectural objects.

ARCH 6426. 3D Modeling in Architecture
1-6-3.
Construction of 3D computer models of architectural structures. Topics include: geometry creation, light and materials property, rendering, data exchange, and basic animation.

ARCH 6427. Advanced Modeling and Animation in Architecture
1-6-3. Prerequisite(s): ARCH 6426
Advanced computer modeling of architectural form. Topics include: parametric design, parametric materials, special effects, object libraries, animation and video production.

ARCH 7000. Thesis
Credit hours to be arranged

ARCH 7042. Urban Design Workshop
0-9-3.
Advanced problems in urban design and development focusing on the Atlanta region. Integration of urban design theory and methods, economic development, political registration, and communication.

ARCH 7043. Urban Design Workshop
0-12-4.
Advanced problems in urban design and development focusing on the Atlanta region. Integration of urban design theory and methods, economic development, political registration, and communication.

ARCH 7044. Urban Design Workshop
0-15-5.
Advanced problems in urban design and development focusing on the Atlanta region. Integration of urban design theory and methods, economic development, political registration, and communication.

ARCH 7045. Urban Design Workshop
0-18-6.
Advanced problems in urban design and development focusing on the Atlanta region. Integration of urban design theory and methods, economic development, political registration, and communication.

ARCH 7060. Critical Positions in Architectural Design
3-0-3. Prerequisite(s): ARCH 6131 and ARCH 6132
Advanced topics in the theory of architectural production focusing upon contemporary ethical dilemmas and the development of critical positions of design.

ARCH 7090. Master's Project Studio
0-18-6. Prerequisite(s): ARCH 6031 and ARCH 6032 and ARCH 6033 and ARCH 7060
Comprehensive studio problems emphasizing the integration of disciplinary and professional skills through the formulation of architectural propositions grounded in critical, speculative, and creative research.

ARCH 8801-2-3-4-5-6. Special Topics
Credit hours equal the last digit in the course number.

ARCH 8811. Special Topics: Architectural Design
0-3-1.

ARCH 8812. Special Topics: Architectural Design
0-6-2.

ARCH 8813. Special Topics: Architectural Design
0-9-3.

ARCH 8814. Special Topics: Architectural Design
0-12-4.

ARCH 8815. Special Topics: Architecutral Design
0-15-5.

ARCH 8821-2-3. Special Topics: History, Theory, and Criticism
3-0-3 each.

ARCH 8831-2-3. Special Topics: Architectural Technology
3-0-3 each.

ARCH 8841-2-3. Special Topics: Professional and Social Practice
3-0-3 each.

ARCH 8851. Special Topics: Visual Arts and Design Computing
0-3-1.

ARCH 8852. Special Topics: Visual Arts and Design Computing
0-6-2.

ARCH 8853. Special Topics: Visual Arts and Design Computing
0-9-3.

ARCH 8901-2-3. Special Problems
Credit hours to be arranged

ARCH 8911-2-3-4-5. Special Problems: Architectural Design
Credit hours to be arranged

ARCH 8921-2-3-4-5. Special Problems: History, Theory, and Criticism
Credit hours to be arranged

ARCH 8931-2-3. Special Problems: Architectural Technology
Credit hours to be arranged

ARCH 8941-2-3. Special Problems: Professional and Social Practice
Credit hours to be arranged

ARCH 8951-2-3. Special Problems: Visual Arts and Design Computing
Credit hours to be arranged

ARCH 8997. Teaching Assistantship
Credit hours to be arranged
For graduate students holding graduate teaching assistantships.

ARCH 8998. Research Assistantship
Credit hours to be arranged
For graduate students holding graduate research assistantships.

ARCH 9000. Doctoral Dissertation
Credit hours to be arranged

BUILDING CONSTRUCTION

BC 2600. Construction Contracting
3-0-3. Prerequisite(s): BC 2610
The goal of this course is to teach students basics of construction contracting, business methods, organizational models, bidding, construction insurance, and labor relations.

BC 2610. Construction Technology I
2-3-3.
An introduction to the planning and physical development process for the construction of projects of residential and light construction scale.

BC 2620. Construction Technology II
2-3-3. Prerequisite(s): BC 2610
A continuation of Construction Technology I with an emphasis on large-scale and high-rise building, i.e., heavy building construction.

BC 2630. Construction Seminar
1-0-1.
Provides an introduction to the construction industry with emphasis on exploring career opportunities in construction.

BC 3600. Construction Cost Management
2-3-3.
Introduction to cost principles and cost analysis of construction projects, including classification of work, quantity survey techniques, construction operation costs, and bid proposals.

BC 3610. Construction Law
3-0-3.
Legal aspects of construction contracts, bonds, insurance, and bidding. Owner, architect, contractor, and subcontractor relationships.

BC 3620. Real Estate and Construction Finance and Accounting
3-0-3.
General introduction to the financing of construction and real estate development projects. Emphasis on financing requirements, activities, sources and uses.

BC 3630. Project Management I
2-3-3.
This course will offer construction planning and management techniques for project design and construction with a focus on different scheduling methods and their use.

BC 4600. Project Management II
3-0-3.
This course covers practical project management, technology, and tools for this approach and required management skills for successful execution of projects.

BC 4610. Value Engineering and Building Economics
3-0-3.
First part is an introduction to principles and methodology. Second part is an introduction to economic principles and theories and how to apply the concepts and methods of building economics.

BC 4620. Building Structural Analysis
3-0-3.
Emphasis being placed on the practical design and construction of structural elements. The course includes basic design principles with a heavy emphasis on constructability and buildability.

BC 4630. Senior Capstone Project
2-3-3. Prerequisite(s): BC 3600 and BC 3610 and BC 3630
A senior construction terminal project that includes redevelopment analysis and feasibility study, project development, and construction.

BC 4640. Construction Marketing and Ethics
3-0-3.
Methods of construction marketing and business development. Innovative computer applications, verbal skills development, professional strategies, market segmentation, and buyer behavior.

BC 4650. Laboratory for Sustainable Design and Construction
1-3-3.
The goal of the laboratory is to teach students a comprehensive sustainable design and construction information system and a program of real-world, hands-on projects.

BC 4660. Entrepreneurship in Construction
3-0-3.
Basics of construction business risk assessment, looking for construction opportunities, capital investment, computerized construction business, and business failures.

BC 4670. Construction Industry Issues and Initiatives
3-0-3.
Major issues of the construction industry in productivity improvement, constructability, quality improvements, safety, computers, and innovative construction management.

BC 4801-2-3. Special Topics
Credit hours equal the last digit in the course number.

BC 4900. Special Problems
Credit hours to be arranged

COLLEGE OF ARCHITECTURE

COA 1011. Fundamentals of Design and the Built Environment I
0-9-3. Co-requisite: ARCH 1060.
Introduction to creative problem solving and the design realization cycle through project-based design exercises that emphasize the role of representation.

COA 1012. Fundamentals of Design and the Built Environment II
1-9-4. Prerequisite(s): COA 1011
Introduction to the design of complex problems through an emphasis on integrative and collaborative design strategies, research, critical reflection, and interdisciplinary team work.

COA 1060. Introduction to Design and the Built Environment
3-0-3. Co-requisite: COA 1011.
Introduction to architecture, building construction, and industrial design through case studies that illuminate past and present practices, as well as future possibilities within the disciplines.

COA 2115. Art and Architecture in Italy I
3-0-3.
Investigations of the painting, sculpture, and architecture of the Classical, Early Christian, Byzantine, and Medieval periods in Italy with special emphasis on Rome.

COA 2116. Art and Architecture in Italy II
3-0-3.
Investigations of the painting, sculpture and architecture of the Renaissance and Baroque periods in Italy with special emphasis on the works of Rome.

COA 2241-2. History of Art I, II
3-0-3 each.
A survey of artistic manifestations from primitive times to the present. First semester sequence, prehistoric through Renaissance; second semester, Renaissance through 19th and 20th centuries.

COA 6115. Art and Architecture in Italy I
3-0-3.
Investigations of the painting, sculpture, and architecture of the Classical, Early Christian, Byzantine and Medieval periods in Italy with special emphasis on Rome.

COA 6116. Art and Architecture in Italy II
3-0-3.
Investigations of the painting, sculpture, and architecture of the Renaissance and Baroque periods in Italy with special emphasis on the works of Rome.

COA 8000. Doctoral Seminar
1-0-1.

COA 8510. Research Design in Planning
3-0-3.
Examines the theoretical and practical foundations of research design within the field of city and regional planning.

COA 8520. Advanced Planning Theory
3-0-3.
Advanced seminar on planning theory, including philosophy of sciences, political philosophy, and ethical theory. The course explores the theoretical basis for planning as a social activity.

COA 8600. The Genesis of Architecture
3-0-3.
The nature of architecture illustrated from those of all cultures; determinist theories; its social values and its meanings to the individual material, physical, anthropological, and cognitive.

COA 8610. Thought and Interpretation in Architecture from the Hellenic Period to the 1830s
3-0-3.
A survey of architectural thought and theory taking account of other fields; paralleled by a review of major critical texts and assessments to the present day.

COA 8612. Thought and Interpretation in Architecture from the 1830s to the 20th Century
3-0-3.
A survey of architectural thoughts and theory taking account of the fields; paralleled by a review of major critical texts and assessments to the present day.

COA 8620. The Design and Evolution of American Space
3-0-3.
Topical seminar on the development of urban, suburban, and rural American spatial forms, with emphasis on the relationship between public order and vernacular settlement.

COA 8625. Theories of Inquiry in Architecture
3-0-3.
Introduction to research paradigms and their assumptions. The formulation of questions and frameworks of description, representation, analysis, interpretation, and data control.

COA 8630. Theories of Architecture, Space, and Culture
3-0-3.
Accounts of the social functions of architectural space and associated design choices, across a variety of building types and scales of environmental design.

COA 8635. Architecture and Policy: Linking Theory and Practice
3-0-3.
Methods and theories of planning, design, facilities management, and evaluation as they relate to organizational policy and development.

COA 8640. Theories of Psychology for Architecture
3-0-3.
An examination of social and psychological theory as it is applied to the creation and use of space.

COA 8645. Analytical Models of Built Space and Its Functions
3-0-3.
Introduction to analytical ideas and methodologies for the quantitative description of built space, form, building use, and functions. Layouts as configurations: boundaries, accessibility, visibility, extensions.

COA 8650. Formal Descriptions of Designs: Analyses of Space, Shape, and Form
3-0-3.
Introduction to the form and computational description of designs, with an emphasis on spatial patterns. Geometrical constructions; combinatorial approaches, analyses of shape.

COA 8670. Design of Design Environments
3-0-3.
Analysis of design processes; analysis of current design tools at both the user interface and functional levels; procedures for developing better design tools.

COA 8672. Research Seminar in Design Computation
3-0-3.
Seminar review of developments in computing applied to architecture; current major research issues.

COA 8674. Structuring Multimedia Design Knowledge
3-0-3.
Theories and tools for structuring multimedia knowledge for design and designers.

COA 8676. Design and Engineering Databases
3-0-3.
Survey of database use in design and engineering; surveys relational, object-oriented database technology, and ISO-STEP methods of integration.

COA 8678. Geometric Modeling Software Development for Architecture and Building
3-0-3.
Software development course focusing on 3D geometric constructions and modeling; emphasizes solid modeling and its role in design.

COA 8680. Performance Aspects of Building Systems Design
3-0-3.
Engineering analysis of building (sub) systems based on a performance ontology. Criteria, metrics, and tools for performance aspect evaluations in different building technology domains.

COA 8685. Building Performance Simulation
3-0-3.
Numerical simulation of performance characteristics of whole buildings. Review of the finite element method for uniform treatment of transport phenomena in different building technology domains.

COA 8690. Integrated Design and Engineering Environments for Buildings
3-0-3.
Surveys of issues for effective integration of heterogeneous design tools for building; previous efforts, current approaches; advanced techniques, including ISO-STEP and IAI.

COA 8811-2-3. Special Topics in Architectural/Planning Studies
Credit hours equal the last digit in the course number.

COA 8821-2-3. Special Topics in Architecture and Behavior
Credit hours equal the last digit in the course number.

COA 8831-2-3. Special Topics in Design and Technology
Credit hours equal the last digit in the course number.

COA 8841-2-3. Special Topics in Design Computing
Credit hours equal the last digit in the course number.

COA 8851-2-3. Special Topics in History and Theory
Credit hours equal the last digit in the course number.

COA 8861-2-3. Special Topics in History and Theory
Credit hours equal the last digit in the course number.

COA 8996. Qualifying Paper
Credit hours to be arranged

COA 8997. Teaching Assistantship
Credit hours to be arranged
For students holding a graduate teaching assistantship.

COA 8998. Research Assistantship
Credit hours to be arranged
For students holding a graduate research assistantship.

COA 8999. Preparation for Doctoral Dissertation
Credit hours to be arranged

COA 9000. Doctoral Thesis
Credit hours to be arranged

CITY PLANNING

CP 4010. Foundations of Urban and Regional Development
3-0-3.
The course describes the economic function of cities and the significant factors that shape their growth and development.

CP 4020. Introduction to Urban and Regional Planning
3-0-3.
This course provides an overview of the planning of cities and metropolitan regions. The legal and historical context as well as substantive areas of urban planning are addressed.

CP 4030. The City and Its Technology
3-0-3.
This course places urban infrastructure technology within the larger context of planning and development. The social and economic aspects of these systems are highlighted.

CP 4040. The City in Fiction and Film
3-0-3.
Examines images and perceptions of the urban environment as portrayed in literature and cinema. Explores the social, economic, and cultural contexts that impact on conception of the city.

CP 4050. Negotiation, Facilitation, and Conflict Management
3-0-3.
Theoretical and practical instruction on techniques of negotiation and consensus building using case studies and training exercises.

CP 4210. Environmental Planning and Impact Assessment
3-0-3.
Covers the principles of environmental planning and decision making. Examines the methods and processes, and environmental impact assessment and regulation.

CP 4310. Urban Transportation and Planning
3-0-3.
This course is designed to introduce the fundamentals of urban transportation planning and policy and is applicable to students in a variety of concentrations of study. The purpose of the course will be to acquaint students with transportation planning as a profession and the types of projects that transportation planners are required to conduct.

CP 4510. Fundamentals of Geographic Information Systems
3-0-3.
The course provides a basic understanding of the tools for collecting, storing, and analyzing spatially distributed data. Basic issues of software design and application are covered.

CP 4610. Introduction to Real Estate Investment
3-0-3.
Introduction to real estate analysis and utilization. Subjects include attributes of real property, value determinations, appraisal, investment analysis, market analysis, asset management, and public aspects.

CP 4620. Housing and Real Estate Economics
3-0-3.
Examination of private and public sector approaches to housing. Economic theory of durable goods, demand elasticities, applied market research analyses, and history of public intervention.

CP 4801-2-3. Special Topics
3-0-3 each.

CP 6001. Introduction to Fields of Planning
1-0-1.
Introduction to the various subfields of planning through reading, discussion, and guest lectures by practicing planners.

CP 6012. Theory and History of Planning
4-0-4.
Examines theories of planning and the public interest. Considers the roles of planners within the American political system and the historical development of the planning profession.

CP 6016. Growth Management Law and Implementation
3-0-3.
Study of legal framework of planning, including subdivision and zoning regulations and their implementation. Analysis of the constitutional issues of growth management.

CP 6022. Quantitative Methods
3-3-4.
Introduction to quantitative methods in planning; including descriptive and inferential statistics, linear regression and analysis of variance and how they are applied to planning problems.

CP 6023. Advanced Planning Methods
3-0-3.
Quantitative methods including commonly used data sources, data presentation, and analysis of qualitative data.

CP 6031. Economic Analysis for Planning
3-0-3.
Applications of economic theory to planning, including market theory, public finance, cost benefit analysis, and project economics.

CP 6032. Urban and Regional Development Theory
3-0-3.
Study of theories in the structure and function of cities and regions. Emphasis on the economic forces shaping urban development.

CP 6034. Demographic and Economic Analysis of Urban Areas
3-0-3.
This course considers the social and economic structure of urban areas from a demographic perspective. Population structure, population change, and migration are explored.

CP 6052. Applied Planning Studio
0-12-4. Prerequisite(s): CP 6112
Analysis and preparation of alternatives for an existing neighborhood, community, or region. Emphasis on application of planning skills in a real-world situation.

CP 6112. Introduction to Land Use Planning
3-0-3.
This course introduces students to land use planning. The basic rationale for land use planning and its form in different states is covered.

CP 6122. Land Use Planning Methods
3-0-3.
This course explores the techniques of land use planning and applies them to specific land use types.

CP 6214. Environmental Planning and Impact Assessment
3-0-3.
Examines the principles, processes, and methods of environmental planning. Focus on environmental science and its use in impact assessment and evaluation.

CP 6223. Policy Tools for Environmental Management
3-0-3.
The course covers the regulatory, market, and procedural tools used to manage the environment. It examines the strengths and weaknesses of alternative techniques.

CP 6233. Sustainable Urban Development
3-0-3.
Explores the principles and practice of sustainable urban development. Urban and regional planning provides an integrative framework for examining different perspectives of sustainability.

CP 6241. Water Resources Planning
3-0-3.
Fundamentals of water resources planning and stormwater management. Emphasis on urban water resources problems, policies, and practices.

CP 6250. Hazardous Waste Planning and Management
3-0-3.
Examines the planning tools and management techniques for the proper use, storage, transport, and disposal of hazardous material and waste products.

CP 6261. Environmental Law
3-0-3.
This course introduces students to the framework of legislation that shapes environmental planning and policy, including NEPA, Clean Air Act, and Clean Water Act.

CP 6311. Introduction to Transportation Planning
3-3-4.
Overview course in transportation planning including basic principles to understanding transportation, current transportation problems, transportation policy and decision-making processes and methods.

CP 6321. Transportation Planning Methods and Investment Decisions
3-3-4. Prerequisite(s): CP 6311
Review of transportation methods and how they interface with investment decisions. How transportation planners at the local, regional, state, and federal levels employ methods.

CP 6331. Land Use and Transportation Interaction
3-0-3. Prerequisite(s): CP 6311
Overview of land use and transportation planning principles, how development impacts air transportation, how transportation investments impact development patterns and air quality.

CP 6341. Urban Design and Non-Motorized Accessibility
3-0-3.
Examines role and opportunity to make walking and biking viable travel options in urban environments and how urban environments need to be designed to encourage non-motorized travel.

CP 6351. Transportation and Economic Development
3-0-3.
Impact of transportation infrastructure investments on economic outcomes at a range of geographic scales including neighborhood, municipality, regional, and statewide.

CP 6361. Regional Transportation Planning and Administration
3-0-3.
This course will address the administrative, political, methodological, and social issues underlying the regional transportation planning process.

CP 6412. Foundations of Local Economic Development Planning and Policy
3-0-3.
Introduction to local economic development planning, examining theory, process and practice, international and regional factors, public and private roles.

CP 6422. Economic Development Analysis and Practice
3-0-3.
This course focuses on strategy development, methods of analysis, and approaches to practice for urban and regional economic development policy and planning.

CP 6432. Industrial Restructuring and Its Planning Implications
3-0-3.
Examines industrial restructuring trends and theoretical frameworks; develops industry case studies; and considers economic development planning's role in industrial restructuring.

CP 6442. Equity, Social Justice, and Economic Development
3-0-3.
Explores concepts and theories of equity and social justice, analysis of indicators of (in)justice/equity, and economic development planning's role in promoting equity and social justice.

CP 6452. Urban Development Policy
3-0-3.
Introduces elements of urban policy and economic development by examining them historically, nationally, and locally. Approaches to urban development and redevelopment are analyzed.

CP 6514. Introduction to Geographic Information Systems
3-0-3.
This course introduces students to spatial analysis using geographic information systems. Fundamentals of software design and geographic data are covered.

CP 6521. Advanced Geographic Information Systems
2-1-3. Prerequisite(s): CP 6611
The course provides students with advanced spatial analysis techniques including network analysis, three-dimensional surface modeling, and GIS application development.

CP 6531. Introduction to Remote Sensing
3-0-3.
This course introduces students to the collection and use of satellite imagery and other remote sensing data.

CP 6541. Environmental Analysis Using GIS
3-0-3. Prerequisite(s): CP 6611
This course focuses on the application of geographic information systems (GIS) to environmental problems. It highlights the types and sources of data appropriate to those applications.

CP 6551. Spatial Analysis of Socioeconomic Data
3-0-3. Prerequisite(s): CP 6611
This course provides students with an in-depth study of the spatial distribution of human activity, including population, housing, and employment.

CP 6561. Geodemographics: Data Sources and Methods
1-6-3.
Explores important secondary data sources used by planners and analysts working with smaller geographic areas. Experience with hardware and software used to analyze data.

CP 6611. Principles of Real Estate Finance and Development
3-0-3.
Introduction to principles of real estate finance, investment, and development including productivity analysis, structure of capital markets, yield and capitalization, equity investment, and portfolio analysis.

CP 6621. Real Estate Market Research
3-0-3
Introduction to real estate market research with particular focus on analyses of housing and office markets.

CP 6630. Government and Housing Markets
3-0-3.
Examination of the operation of local housing markets and national, state, regional, and local housing policies.

CP 6640. Applied Real Estate Development Methods
3-0-3. Prerequisite(s): CP 6421 and CP 6431
Application of the development process, market and financial feasibility analyses, and public policy to large development projects. Extensive use of case studies involving professional developers.

CP 6755. Land Use-Transportation Interaction
3-0-3. Prerequisite(s): CP 6310
Overview of land use and transportation planning principles, how development impacts transportation, how transportation investments affect development patterns and air quality. Crosslisted with CEE 6755.

CP 6811. Negotiation, Facilitation, and Conflict Management
3-0-3.
Theoretical and practical instruction on techniques of negotiation and consensus building using case studies and training exercises.

CP 6815. Cinema City
3-0-3.
Explores people's response to cities, augmenting the empirical analysis that is urban studies domain with the subjective perspectives of cinematic artists.

CP 6821. Basic Methods of Policy Analysis and Planning
3-0-3.
Synthesizes elements of the program core's analytic techniques and employs them in a case study context. Cases address urban policy, planning, and management.

CP 6825. Public Sector Finance and Budgeting
3-0-3.
Theory and practice of public finance. Emphasis on applications in local government revenue collection, budgeting, and expenditure analysis.

CP 6831. Urban Growth and Infrastructure Systems
3-0-3.
This course provides students with a basic understanding of urban infrastructure systems and their role in shaping urban growth and development.

CP 6832. Introduction to Urban Design
3-0-3.
An introduction to the study, research, and practice of urban design examining traditional design principles and their application to the contemporary city.

CP 6834. Urban Design Policy: Analysis and Implementation
3-0-3. Prerequisite(s): CP 6832
Urban design policy making and its implementation including an analysis of the behavioral basis for policies that promote quality in built form.

CP 7000. Master's Thesis
Credit hours to be arranged
Provides students with an opportunity to pursue advanced research under the guidance of a faculty committee.

CP 7090. Applied Research Paper
4-0-4.
The applied research paper requires students to demonstrate their ability to organize and execute professional-level work in consultation with a faculty member.

CP 8000. Doctoral Planning Seminar
1-0-1.
This course provides students and faculty an opportunity to present and discuss planning research.

CP 8800. Special Topics in City Planning
3-0-3.
Special topics of current interest in city planning.

CP 8801. Special Topics in Land Use Planning
3-0-3.
Special topics of current interest in land use planning.

CP 8802. Special Topics in Environmental Planning
3-0-3.
Special topics of current interest in environmental planning.

CP 8803. Special Topics in Transportation Planning
3-0-3.
Special topics of current interest in transportation planning.

CP 8804. Special Topics in Economic Development
3-0-3.
Special topics of current interest in economic development.

CP 8805. Special Topics in Planning Methods
3-0-3.
Special topics of current interest in planning methods.

CP 8806. Special Topics in Land Development
3-0-3.
Special topics of current interest in land development.

CP 8808. Special Topics in Urban Development
3-0-3.
Special topics of current interest in urban development.

CP 8900-1-2. Special Problems
Credit hours to be arranged
Special problems of current interest.

CP 8997. Teaching Assistantship
Credit hours to be arranged
For graduate students holding graduate teaching assistantships.

CP 8998. Research Assistantship
Credit hours to be arranged
For graduate students holding graduate research assistantships.

CP 9000. Doctoral Dissertation
Credit hours to be arranged

INDUSTRIAL DESIGN

ID 2011. Introductory Design I
0-12-4. Prerequisite(s): COA 1012
Foundation course in visual communications theory and practice, continuing the development of two-dimensional visual literacy. Emphasis on both analog and digital media.

ID 2012. Introductory Design II
0-12-4. Prerequisite(s): ID 2011
Foundation course in form giving and representing, continuing the development of three-dimensional visual literacy. Emphasis on visual relationships between form and image.

ID 2201. Sustainable Issues for Design
3-0-3. Co-requisite: ID 2011.
Introduction to the broad environmental issues that face humankind as a participant in the biosphere.

ID 2202. History of Modern Industrial Design
3-0-3.
History and development of industrial design from the beginning of the Industrial Revolution to the present.

ID 3011. Intermediate Design I
2-9-5. Co-requisite: ID 3301.
The systematic design process as applied to industrial design and packaging problems.

ID 3012. Intermediate Design II
2-9-5. Co-requisite: ID 3302.
Various dimensions of human factors applied to design, including: aging, disability, normal age change, childhood and adult anthropometrics, and human capability.

ID 3101. CAD I
1-6-3.
3D solids, surface, and assemble modeling.

ID 3102. CAD II
1-6-3. Prerequisite(s): ID 3101
Introduction to CAD systems and 3D modeling.

ID 3301. Materials I: Renewables
2-3-3. Co-requisite: ID 3011.
This course examines the characteristics, production technologies, histories, and environmental impacts of nine categories of renewable materials familiar to industrial design.

ID 3302. Materials and Processes II: Non-Renewables
2-3-3. Prerequisite(s): ID 3301
Examination of characteristics, production technologies, histories, and environmental impacts of non-renewable materials used in industrial design.

ID 3801-2. Special Topics
3-0-3, each.

ID 3901-2. Special Problems
Credit hours to be arranged

ID 4011. Advanced Design I
1-12-5. Prerequisite(s): ID 3012 and ID 3302; Co-requisite: ID 4201.
Application of the design process to advanced multidisciplinary design problems. Experience in solving real design problems from areas such as consumer products and equipment, transportation and equipment.

ID 4012. Advanced Design II
1-12-5. Prerequisite(s): ID 4011; Co-requisite: ID 4201.
Capstone industrial design project of student's own choosing with consent of instructor, to refine problem-solving and design ability in preparation for professional practice.

ID 4103. Alias Studio I
0-9-3.
Introduction to modeling, rendering, and animation with Alias Studio software.

ID 4104. Alias Studio II
0-9-3. Prerequisite(s): ID 4911
Introduction to product animation using Alias Studio software.

ID 4201. Design/Research Methods
3-0-3.
Research methods applicable to industrial design including task definition, information gathering, and analysis.

ID 4202. Professional Practice and Preparation
3-0-3. Prerequisite(s): ID 4011
Principles of consulting and corporate industrial design including preparation of the professional portfolio.

ID 4203. French Society and Culture
3-0-3.
Studies in French society and culture.

ID 4204. Theorizing Design
3-0-3.
Introduction to what designers do and how they undertake their tasks; examples will come from a variety of design disciplines.

ID 4205. French Design and Culture
3-0-3.
Studies in French design and culture.

ID 4801. Special Topics: Sustainability
3-0-3.
Special topics in sustainability not included in the professional curriculum.

ID 4802. Special Topics: Information Technology
3-0-3.
Special topics in information technology not covered in the professional curriculum.

ID 4803. Special Topics: Furniture
3-0-3.
Special topics in furniture design not covered in the professional curriculum.

ID 4804. Special Topics: Collaborative
3-0-3.
Application of the design process to advanced multidisciplinary problems by a team. Projects from a range of interest areas: consumer, industrial products, transportation, furniture.

ID 4805. Special Topics: History and Theory
3-0-3.
Special topics in history and theory not covered in the professional curriculum.

ID 4900. Special Problems: Visual Communications
Credit hours to be arranged
Special communications not covered in the professional curriculum.

ID 4901-2. Special Problems: Mentor Program
Credit hours to be arranged
Special problems in teaching pedagogy; mentoring by senior faculty in basic and intermediate design courses.

ID 4903-4. Special Problems: Research
Credit hours to be arranged
Special research topics for advanced students not covered in the professional curriculum.

Department of Music

Location: Couch Building
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christine.marks@music.gatech.edu
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www.arch.gatech.edu/music

Department Chair and Director of Bands–Bucky Johnson; *Associate Director of Bands and Director of Symphonic Winds*–Andrea Strauss; *Director of Jazz Ensemble and Director of Orchestra*–Ron Mendola; *Interim Director of Choral Activities*–William Caldwell; *Composer In Residence*–James Oliverio; *Assistant Band Director and Percussion Instructor*–Chris Moore.

General Information

Music activities at Georgia Tech have traditionally centered around three enthusiastic and well known performing groups: Band, Chorale, and Jazz Ensemble. The Music Department is quite active, although there are no music majors or music degrees at Tech. Students involved in the program represent every major of the Institute on both undergraduate and graduate levels. Participants earn academic credit that counts toward free-elective or humanities requirements.

Excellence in the program is clearly demonstrated in the level of student performance and the vitality and rapid growth of the program. Expanded course offerings have allowed for the creation of a Certificate of Fine Arts-Music. Course offerings in music history, music theory, and music technology are designed to serve the general student population. Specific offerings should be checked each semester in the On-line Student Computer-assisted Registration booklet. The Department plans its events with awareness of other demands upon Tech students so that a great amount of musical experience is concentrated into a limited time. All ensemble classes schedule meetings and rehearsal times during the late afternoon and early evening hours. The Department enjoys a tradition of commitment to campus and community service and contributes greatly to the quality of life at Georgia Tech.

Humanities Credit for Ensemble Participation

Students are permitted to earn six hours of humanities credit for participating in ensembles in the Music Department, provided the selection and concentration criteria are satisfied. Specifically, the selection must satisfy Criterion 1, and the concentration must satisfy either Criterion 2 or Criterion 3.

Criterion 1. The ensemble is chosen from the following list: Percussion Ensemble, Chamber Orchestra, Chorale, Concert Band, Jazz Ensemble, Symphonic Band, Vocal Ensemble, and Men's Glee Club.

Criterion 2. The student earns at least four credits in one of the ensembles chosen from the list in Criterion 1.

Criterion 3. The student earns at least four credits in a combination of Symphonic Band and Concert Band.

Certificate in Fine Arts - Music

A Certificate in Fine Arts - Music can be earned by Georgia Tech students upon completion of 13 hours of course work in music as approved by the Music Department program coordinator. Students following certificate guidelines will be exposed to an introduction to fine arts, including the development of personal aesthetic and critical skills, and will go on to more indepth study in music analysis and history. A core component of this program involves sustained performance in one of Georgia Tech's instrumental or vocal ensembles.

At least nine hours must be at the 3000 level or higher. All other Undergraduate Certificate Academic Requirements as they appear in the Undergraduate Certificate Program Guidelines must be met. Courses must be taken on a letter-grade basis, and a grade of *C* or better must be received in order to obtain course credit toward the certificate. This certificate program is designed mainly for students with an interest in gaining an indepth knowledge of music within the context of a technical undergraduate education.

Required and elective courses are as follows:
Required courses (11 credit hours):

- 3 hours of Survey of Music Technology (MUSI 3450)
- 2 hours of Composers and Their Music
- 2 hours of Music Theory (MUSI 2600, 3600)

4 hours core from one of the following areas:
Band (Concert Band - MUSI 1102-3, 2102-3, 3102-3, 4102-3 and/or
Symphonic Band (1112-4, 2112-4, 3112-4, 4112-4)
Chamber Ensemble (MUSI 1401-3, 2401-3, 3401-3, 4401-3)
Chorale (MUSI 1201-3, 2201-3, 3201-3, 4201-3)
Jazz (MUSI 1301-3, 2301-3, 3301-3, 4301-3)
Orchestra (MUSI 1601-3, 2601-3, 3601-3, 4601-3)
Vocal Ensemble (MUSI 1211-3, 2211-3, 3211-3, 4211-3)

Elective courses (2 credit hours):
2 hours of elective music courses with MUSI prefix.

Athletic Bands
The Marching Yellow Jackets and Pep Bands are elements of the Georgia Tech Band Program. Since its inception in 1908, it has fulfilled two primary goals: to represent the Institute and to provide a musical outlet for Tech students. The Marching Band and Pep Band travel to several out-of-state events, including the ACC Tournament, NCAA Tournament, football games, and bowl appearances. These trips are financed by the Georgia Tech Athletic Association. The Georgia Tech Marching Band is one of the most well known musical organizations at Georgia Tech. The band performs at football games and makes special appearances during the year. Tryouts for the auxiliary units are held each spring and include flagline and majorettes. There is a band camp preparation the week before fall classes begin.

The *Georgia Tech Marching Band Handbook* provides detailed information about the organization. Please contact the Music Department for further information.

Concert Band
The Concert Band is available during second semester and is sometimes offered during the summer term. It is open to experienced wind and percussion players. This is a performing ensemble that covers both traditional and contemporary music at a grade IV and V level. Students can earn humanities credit by participating in a series of Concert Band and/or Symphonic Band courses.

Symphonic Band
An auditioned instrumental ensemble for the more serious student has established a reputation of musical excellence through the performance of grade V, VI band literature. Individual performance time, sectionals, and a high level of musical standards in rehearsals are expected. Repertoire has consisted of the compositions of Grainger, Persichetti, Copland, Bernstein, Hindemith, Giannini, and Holst. Guest clinicians and conductors are frequently invited to enhance performance preparation. Auditions are scheduled by contacting the director before the first day of class.

Orchestra
The Georgia Tech Orchestra (referred to as the University Orchestra in catalog listings) is a relatively young ensemble, founded to serve the expressed interests of string students, and quickly growing to symphonic orchestration including brass, woodwinds, and percussion. The group performs a balance of baroque, classical, romantic, contemporary, and popular literature. Orchestra concerts have become a campus tradition each year in the College of Architecture lobby, as a major part of Parent's Weekend, in the Holiday concert, and in many other community appearances. Auditions are scheduled by contacting the director before the first day of class.

Jazz Ensemble
The Jazz Ensemble marked its 20th year during the 1996-97 concert season. Repertoire ranges from the concert jazz compositions of Leonard Bernstein, Duke Ellington, and Stan Kenton to the contemporary works of Bob Mintzer and Pat Metheny, and to works commissioned for the band. The group performs at area jazz festivals and has appeared in hundreds of concerts on campus and in the community. Members sharpen their improvisational skills and strive to grow as instrumentalists in the various jazz styles. Students rightfully take pride in the group's accomplished level of performance. Professional clinicians, guest artists, and conductors bring additional musical perspective. Auditions are scheduled by contacting the director before the first day of class.

Chamber Ensembles

Small ensembles for experienced instrumentals are organized prior to the first day of classes and must be pre-approved by a faculty member in the Music Department. These ensembles may include; string quartet, brass quintet, woodwind quintet, clarinet quartet, trumpet quartet, saxophone quartet, flute choir, etc. Students receiving class credit for these chamber groups must rehearse two to four hours a week and must be coached by a faculty member. Performances vary depending on the semester and may include appearances at school-related functions.

Percussion Ensemble

The Percussion Ensemble focuses on traditional and contemporary ensemble literature as well as transcriptions of popular music. This ensemble is offered to students with prior percussion background. In the fall it serves as the marching percussion section of the Marching Yellow Jacket Band.

The Chorale

With approximately 110 singers, the Chorale is Georgia Tech's largest vocal music organization. Students from nearly every school in the Institute are found among its membership. The Chorale specializes in music written for large groups and performs regularly on campus. The Choir travels extensively during its biennial spring tour.

The Vocal Ensemble

This ensemble of 20-24 singers is selected through audition each spring and performs as the Georgia Tech Chamber Choir in campus and community concerts. Choir rehearses and performs quality choral music literature written especially for smaller choirs.

The Men's Glee Club

The Men's Glee Club was organized on the Tech campus in 1906 and is the oldest student organization on campus. The Glee Club rehearses and performs traditional men's chorus music as well as newer compositions.

Music Technology

"Introduction to Synthesized Computer Music" explores the basic theories of music sequencing and engraving utilizing the computer and integrated synthesizers.

"Survey of Music Technology" is a detailed survey of historic and contemporary electronic music systems, providing an overview of the technological, cultural, and aesthetic factors that have shaped developments in the creation and production of modern electronic music.

"Integrating Music into Multimedia" provides students insight and basic proficiency in current techniques that utilize music and digital audio technologies as part of multimedia productions. Also covered are issues in software/hardware integration, data acquisition from various media, and intellectual property considerations.

Other Special Topics classes, such as "Music Recording & Mixing," "Multi-Media Production & Post-production," and "Music and Sound Design" explore the intersection of music technology and digital media.

Additional Information

Other courses currently taught in the Music Department include "Composers and Their Music" and "Music Theory." Further information is available from the Department of Music at (404) 894-3193, or visit the website at: http://murmur.arch.gatech.edu/music

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

MUSIC

MUSI 1008, 2008, 3008, 4008. Marching Band
0-6-2.

The Georgia Tech Marching Yellow Jackets perform at all home and some away football games. Students are expected to attend a pre-season camp. All conflicts must be approved by director.

MUSI 1102-3, 2102-3, 3102-3, 4102-3. Concert Band
0-3-1.

An instrumental ensemble that performs traditional and contemporary wind literature and is offered to all students with wind, brass, or percussion experience.

MUSI 1112-3-4, 2112-3-4, 3112-3-4, 4112,-3,-4. Symphonic Band
0-3-1. Prerequisite: Audition prior to the first day of class.

An auditioned instrumental ensemble for the more serious student interested in band performance; focusing on musical excellence of grade V, VI band literature. Contact director for audition requirements.

MUSI 1201-2-3, 2201-2-3, 3201-2-3, 4201-2-3. Chorale: Mixed Singing Group
0-3-1. Prerequisite: Choral music experience recommended.
A large ensemble focused on rehearsal and performance of high-quality music of all genres.

MUSI 1211-2-3, 2211-2-3, 3211-2-3, 4211,-2,-3,-4. Vocal Ensemble
0-3-1. Prerequisite: Audition and/or consent of instructor.
An auditioned vocal ensemble for the more serious student of vocal music; focused on rehearsal and performance of high-quality music of all genres.

MUSI 1221-2-3, 2221-2-3, 3221-2-3, 4221-2-3. Men's Glee Club
0-3-1.
An all-male choral ensemble focused on rehearsal and performance of male chorus literature.

MUSI 1301-2-3, 2301-2-3, 3301-2-3, 4301-2-3. Jazz Ensemble
0-3-1.
A traditional 20-member big band and small ensemble specializing in improvisation. Members learn various jazz styles, performance practices, and history.

MUSI 1401-2-3, 2401-2-3, 3401-2-3, 4401-2-3. Chamber Ensemble
0-3-1.
Small instrumental ensembles of various types selected by the director to perform literature for the specific ensemble.

MUSI 1501-2-3, 2501-2-3, 3501-2-3, 4501-2-3. Percussion Ensemble
0-3-1.
Percussion ensemble focuses on traditional and contemporary ensemble literature as well as transcriptions of popular music.

MUSI 1601-2-3, 2601-2-3, 3601-2-3, 4601-2-3. University Orchestra
0-3-1.
The Georgia Tech Orchestra maintains a full complement of woodwinds, brass, percussion, and strings and performs classical through contemporary literature. Contact director prior to the first day of class to arrange an audition.

MUSI 2600. Music Theory I
2-0-2.
Fundamentals of music language to include basic notation, scales, key, signatures, and triads. Ability to read music required.

MUSI 3450. Survery of Music Technology
2-3-3.
A detailed survey of historic and contemporary electronic music systems and their applications in the creation, production, and reproduction of music.

MUSI 3500. Introduction of Synthesized Computer Music
1-3-2.
Introduction of synthesized computer music familiarizes the student with basic sequencing and music engraving using fundamentals of music theory and composition.

MUSI 3600. Music Theory II
2-0-2. Prerequisite(s): MUSI 2600
Advanced music theory including Roman numeral analysis, voice leading in four-part harmony, seventh chords, melodic organization, and modulation.

MUSI 3610. Composers and Their Music: 1500-1800
2-0-2.
The history of western music from the Renaissance to the period of classicism.

MUSI 3620. Composers and Their Music: 1800 to Present
2-0-2.
The history of western music from the period of classicism to present day.

MUSI 3801. Special Topics
0-3-1.
Special ad hoc courses or projects not included in regular course offerings.

MUSI 3802. Special Topics
1-3-2.
Special ad hoc courses or projects not included in regular course offerings.

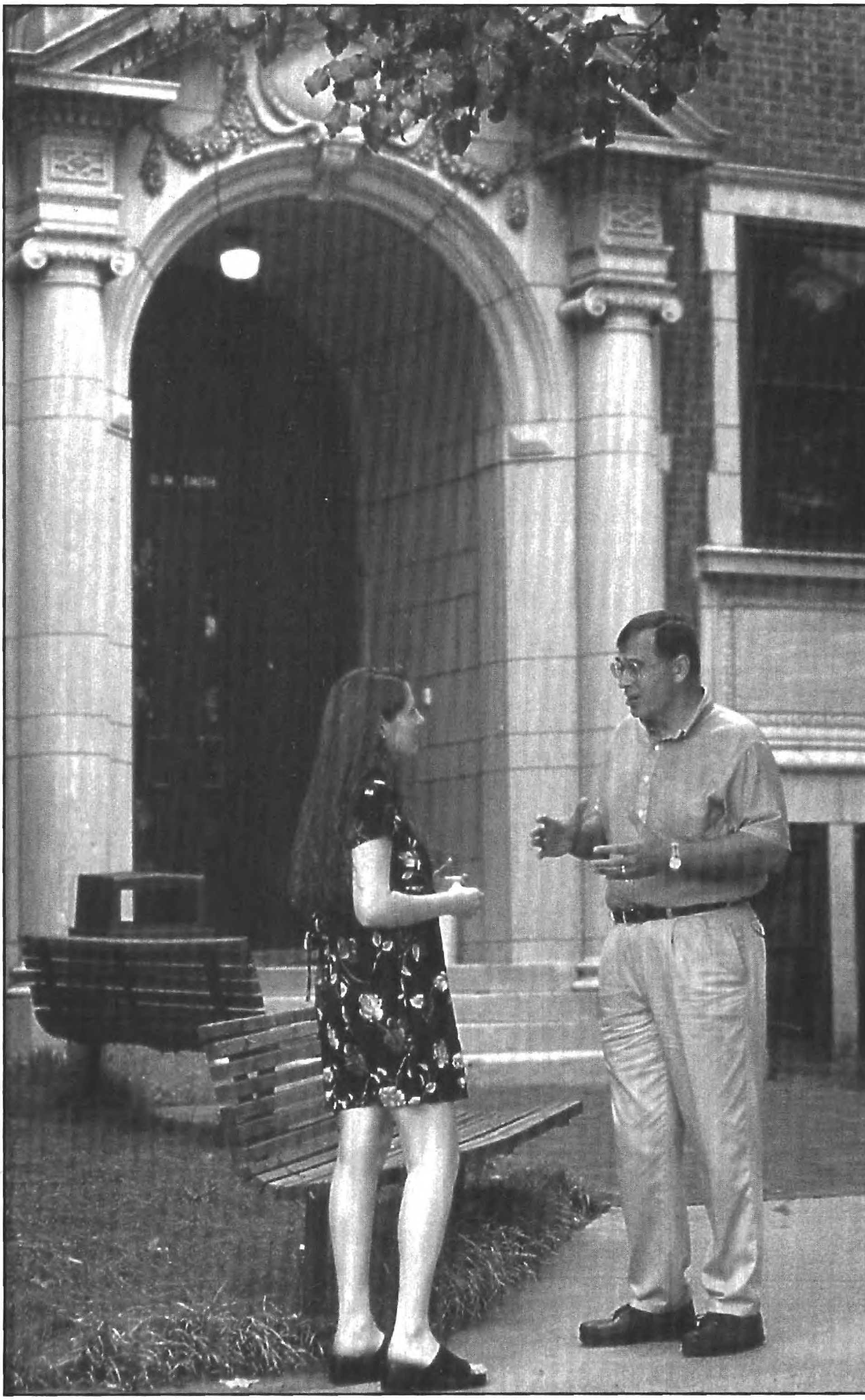
MUSI 3803. Special Topics
2-3-3.
Special ad hoc courses or projects not included in regular course offerings.

MUSI 4450. Intergrating Music into Multimedia
2-3-3.
Techniques for effectively utilizing music and audio in the context of digital multimedia.

MUSI 4801. Special Topics
0-3-1.
Special ad hoc courses or projects not included in regular course offerings.

MUSI 4802. Special Topics
1-3-2.
Special ad hoc courses or projects not included in regular course offerings.

MUSI 4803. Special Topics
2-3-3.
Special ad hoc courses or projects not included in regular course offerings.



College of Computing

WWW.CC.GATECH.EDU/INDEX.HTML

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Dean and Professor–Peter A. Freeman; *Associate Dean and Professor*–Richard J. LeBlanc Jr.; *Assistant Dean*–Kurt Eiselt; *Assistant Dean for Continuing Education*–Tom Pilsch; *Professor and GRA Eminent Scholar in Advanced Telecommunications and Director of the Broadband Telecommunications Center*–John O. Limb; *Professor and Director of the Graphics, Visualization, and Usability Center*–Jarek R. Rossignac; *Principal Research Scientist and Director of the Georgia Tech Information Security Center*–Blaine Burnham; *Professors*–Mustaque Ahamad, Mostafa H. Ammar, Ronald C. Arkin, Albert N. Badre, Jay D. Bolter (adjunct), Mark Borodovsky (adjunct), Lucio Chiaraviglio (emeritus), Charles M. Eastman (joint), Philip H. Enslow Jr., Richard M. Fujimoto, Robert E. Fulton (adjunct), Alton P. Jensen (emeritus), Janet L. Kolodner, Ray Miller (emeritus), Sham Navathe, Nancy Nersessian (joint), Karsten Schwan, Vladimir Slamecka (emeritus), Craig A. Tovey (joint), Vijay Vazirani, Sudhakar Yalamanchili (adjunct), Pranas Zunde (emeritus); *Associate Professors*–Chris Atkeson, Dorrit Billman (adjunct), Richard Catrambone (adjunct), Norberto F. Ezquerra, Ashok K. Goel, Larry F. Hodges, Jessica Hodgins, Howard Karloff, Leo Mark, Milhena Mihael (joint), Edward R. Omiecinski, Colin Potts, Ashwin Ram, Umakishore Ramachandran, John T. Stasko, H. Venkateswaran; *Assistant Professors*–Gregory Abowd, Amy Bruckman, Ann Chervenak, Subhendu (Raja) Das, Irfan A. Essa, John J. Goda Jr., Mark Guzdial, Sven Koenig, Blair MacIntyre, Ken Mackenzie, Elizabeth Mynatt, Dana Randall (joint), Leonard Schulman, Thad Starner, Greg Turk, Ellen Witte Zegura; *Academic Professional*–Russell Shackelford; *Principal Research Scientist*–W. Michael McCracken; *Senior Research Scientists*–William Ribarsky, J. Spencer Rugaber; *Research Scientist II*–Wendy Newstetter; *Instructors*–Dan Colestock, James K. Greenlee, Jon Preston, David Smith, Mani M. Subramanian.

General Information

The founding of the College in 1990 as a focal point for the interdisciplinary advancement of computing caps a history that began in 1963 with the establishment of the School of Information Science. In 1972, this school was succeeded by the School of Information and Computer Science, the immediate predecessor of the current College of Computing. The College is organized around a strong core of computer science that provides the basis for interdisciplinary activities. This approach allows the computing program to build effectively on the strengths of Georgia Tech, accomplished through synergistic linkages to researchers and educators across campus as well as off campus. Computer science is an important part of the basis for many activities and is a natural and powerful partner with a variety of other disciplines.

The College offers instructional and research programs in many areas including algorithms and data structures, artificial intelligence and robotics, computer architecture, cognitive science, databases, distributed and parallel systems, educational technology, graphics and visualization, human-computer interaction, information systems, networking and telecommunications, operating systems, parallel architectures, programming languages, software engineering, and the theories of automata and computation. The College conducts an increasing number of interdisciplinary research and instructional programs jointly with other campus units and operates four centers of interdisciplinary research for the campus: the Graphics, Visualization, and Usability (GVU) Center; the EduTech Institute; the Broadband Telecommunications Center (BTC); and the Georgia Tech Information Security Center (GTISC). The College's operations are housed in parts of five separate buildings on campus, including the College of Computing Building.

The College awards bachelor's, master's, and doctoral degrees in computer science. The College offers an undergraduate Certificate in Information Systems jointly with the DuPree College of Management and a graduate Certificate in Cognitive Science jointly with the schools of Psychology and Industrial and Systems Engineering. The College also offers the M.S. degree in Human-Computer Interaction in collaboration with the School of Literature, Communication, and Culture and the School of Psychology. Master's students may also obtain an interdisciplinary certificate in the Global Innovation for Engineers program. The College is a sponsor of a multidisciplinary program in Algorithms, Combinatorics, and Optimization (ACO), an approved doctoral degree program at Georgia Tech, and master's and doctoral degrees in bioengineering can be pursued through the College as one of the units participating in the Institutewide interdisciplinary Bioengineering Program.

Computing Facilities

The College maintains a variety of computer systems for general support of academic and research activities. These include:

• more than 50 Sun, Silicon Graphics, and Intel systems used as file and compute servers, 10 of which are quad-processor machines, and

• more than 600 workstation class machines from Sun, Silicon Graphics, Intel, and Apple.

A number of specialized facilities augment these general-purpose computing capabilities.

The Graphics, Visualization, and Usability (GVU) Center houses a variety of the most up-to-date graphics and multimedia equipment, including high-performance systems from Silicon Graphics, Sun, Intel, IBM, and Apple. In addition to the main lab, sub-labs provide facilities for specific research areas. These include the Multimedia, Computer Animation, Audio/Video Production, Usability/Human-Computer Interface, Virtual Reality/Environments, Biomedical Imaging, Educational Technology, and Future Computing Environments labs. A partial list of computing and graphics equipment includes:

• Silicon Graphics Onyx2 dual-processor system with InfiniteReality graphics

• Silicon Graphics Onyx dual-processor system with InfiniteReality graphics

• 3 Silicon Graphics Origin200 compute and file servers

• 10 Silicon Graphics Indigo2 systems, 4 with MaxImpact graphics, 6 with Extreme graphics

• 12 Silicon Graphics Indy systems with 24-bit graphics

• 15 Sun SPARC and UltraSPARC workstations

• 12 Intel Pentium PC systems with 24-bit 3D accelerated graphics, 8 of which are dual- or quad-processors

• 3 Xerox/LiveWorks LiveBoards and 3 Smart Technologies SmartBoards

• Polhemus ISOTRAK II and Ascension Flock tracking systems

• Virtual Technologies CyberGlove

• Virtual Research Flight Helmet and EYEGEN3 head-mounted displays

• FakeSpace Virtual Workbench

A Scientific Visualization Laboratory with additional equipment from Silicon Graphics is jointly operated by the GVU Center and the Institute's Office of Information Technology (OIT).

The High-Performance and Parallel Computation Experimentation Laboratory (HPPCEL), another joint operation between the College and OIT, serves as a focus for interdisciplinary research involving high-performance computer systems. Shared facilities include:

• a Silicon Graphics Origin 2000 with 28 R10000 superscalar RISC processors

• a Silicon Graphics Origin 2000 with 16 R10000 superscalar RISC processors

• a cluster of 16 Sun UltraSPARC processors and 5 UltraSPARC dual-processors utilizing Myrinet (16 systems), Dolphin (4 systems), FastEthernet (all systems), and ATM interconnects (all systems)

- a cluster of 16 Pentium quad-processors utilizing Myrinet and full-duplex FastEthernet interconnects
- a cluster of 48 Pentium dual-processors utilizing a full-duplex FastEthernet interconnect
- Sun Media Center 1000E dual-processor video server
- SGI Origin 200 quad-processor video server
- an 8-node IBM SP-2
- an eight-processor IBM RS/6000 Model R50
- a laboratory of Silicon Graphics, Sun, Intel, and IBM workstations

HPPCEL facilities are linked by a dedicated high-performance backbone utilizing OC12C ATM (622 mbps) and Gigabit Ethernet (1000 mbps).

The Networking and Telecommunications group, along with the related Broadband Telecommunications Center (BTC), have several labs equipped with leading-edge computing, communications, and test equipment. These include the Hybrid Fiber/Coax (HFC), Asynchronous Transfer Mode (ATM), Home Information Infrastructure (HII), Protocols, Wireless Technologies, Information Security, and Video Sources Labs.

Other specialized laboratories support research in databases, open systems, software engineering, robotics, and intelligent systems.

All of the College's facilities are linked via local area networks that can provide a choice of switched 10 mbps Ethernet, switched or shared 100 mbps Ethernet, 155 mbps ATM, 622 mbps ATM, or 1,000 mbps Ethernet connections to most locations, including offices, labs, and classrooms. The College's network employs a high-performance OC12C ATM and Gigabit Ethernet backbone with connectivity to the campus backbone provided by an OC12C ATM link and a redundant OC3C ATM (155 mbps) link for failover. The primary campus Internet connection is provided by a direct FDDI (100 mbps) link to the service provider's Atlanta switching center, augmented by an OC3C ATM connection to the NSF vBNS (very high performance Backbone Network Service) research network. Georgia Tech is also leading efforts to establish a southern regional gigabit network as part of Internet2.

Additional computing facilities are provided to the Georgia Tech campus by OIT, including five public-access clusters of Apple, Dell, and Sun workstations, a Sun SPARCcenter 2000 with 12 superscalar RISC processors, and various mainframes.

Undergraduate Program

The undergraduate program in computer science is designed to avoid the fragmentation of subject matter that is apparent in traditional computer science curricula. Rather than divide the aspects of computing expertise into isolated courses (which often obscures the connection between them), the new curriculum integrates the coverage of key aspects of computing. Each course in the first and second years is designed explicitly to teach methods and standards for the analysis, design, implementation, experimentation, and evaluation aspects of solving computational problems. All too often, many of these aspects are overlooked in computer science education.

This program also guarantees that students experience computing as a field of both great challenge and broad applicability. The curriculum includes students from across the spectrum of science, engineering, and other disciplines, ensuring that computing students work in teams with students from other disciplines.

At the freshman level, the first course focuses on the concepts, ideas, methods, and results fundamental to the emerging science of computing. It emphasizes the development of theoretical and empirical skills in the design and analysis of algorithms and data structures. The second course continues the study of algorithms and data structures, stressing algorithm implementation in a high-level structured programming language.

Sophomore-level courses are designed to give students the opportunity to work in areas that are usually reserved for upper-division students, such as systems programming, networking and telecommunications, and human-computer interaction. The sophomore-level courses serve as "gateways" to more advanced courses in order to establish an early foundation, both in knowledge and in applied experience. In addition, while many traditional programs emphasize experience with a particular programming language and environment, our sophomore-level courses provide hands-on training in multiple programming paradigms and languages. This approach ensures that our students will be able to adapt easily to the new languages, environments, and paradigms that they are certain to encounter.

In the junior and senior years, undergraduates develop breadth in computational theory and the social impacts of computing. Students also pursue specialization in three areas of computer science, choosing from areas such as computer systems, data management systems, educational technology, graphics and visualization, intelligent systems, networking and telecommunications, software engineering, theory of computation, and usability. Junior-level students also undertake a capstone design project that allows them to integrate what they have learned in order to solve real-world problems in computing.

Computer science majors take 21 semester hours of free electives, which provide the students with the flexibility to explore areas of study outside computer science or to build more depth within computer science. These free electives offer every CS major the opportunity to create an individualized interdisciplinary program of study.

In addition to the standard four-year plan, a five-year cooperative plan is offered for students who wish to combine their academic education with industry experience. The undergraduate program requires a total of 125 credit hours for graduation, plus a two-hour wellness course. With the exception of free electives, all bachelor of science degree course work must be taken on a letter-grade basis. Up to six hours of free electives may be taken on a pass/fail basis. See page 30 for additional pass/fail restrictions.

The College of Computing requires that all undergraduates who enter the computer science program in summer term 1999 or later must earn a grade of *C* or better in all required CS courses, including CS specialization courses and the CS free elective course. A student whose final grade in a required CS course is a *D* or *F* must retake that course in the next semester it is offered and must earn a *C* or better for that course to be used as credit toward graduation.

Bachelor of Science in Computer Science Curriculum (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
CS 1301	COMPUTER SCIENCE I	3
LAB SCIENCE	(EAS, CHEM, OR BIOL)	4
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		17

First Year - Spring Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
HPS 1040/1061	WELLNESS	2
CS 1050	UNDERSTANDING & CONST. PROOFS	3
CS 1302	COMPUTER SCIENCE II	3
TOTAL SEMESTER HOURS		15

Second Year - Fall Semester

Course Number/Name		*Hours*
PHYS 2211	PHYSICS I	4
MATH 2601	CALCULUS III FOR CS	3
CS 2330	LANGUAGES & TRANSLATION	3
CS 2331	PROGRAMMING PRACTICUM I	2
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
ECE 2030	INTRO. TO COMPUTER ENGINEERING	3
TOTAL SEMESTER HOURS		18

Second Year - Spring Semester

Course Number/Name		*Hours*
PHYS 2212	PHYSICS II	4
MATH 3012	APPLIED COMBINATORICS	3
CS 2340	OBJECTS & DESIGN	3
CS 2341	PROGRAMMING PRACTICUM II	2
CS 2200	COMPUTER SYS. & NETWORKS	4
TOTAL SEMESTER HOURS		16

Third Year - Fall Semester

Course Number/Name		*Hours*
HUMANITIES ELECTIVE		3
CS 3500	THEORY I	4
CS SPECIALIZATION		3
SOCIAL SCIENCE ELECTIVE		3
MATH 3215	PROBABILITY/STATISTICS	3
TOTAL SEMESTER HOURS		16

Third Year - Spring Semester

Course Number/Name		*Hours*
HUMANITIES ELECTIVE		3
CS SPECIALIZATION		3
CS PROJECT		3
SOCIAL SCIENCE ELECTIVE		3
FREE ELECTIVE		3
TOTAL SEMESTER HOURS		15

Fourth Year - Fall Semester

Course Number/Name		*Hours*
CS 4000	COMPUTERIZATION IN SOCIETY	2
CS SPECIALIZATION		3
FREE ELECTIVES		9
LCC 3400	TECHNICAL COMMUNICATIONS	1
TOTAL SEMESTER HOURS		15

Fourth Year - Spring Semester

Course Number/Name		*Hours*
CS SPECIALIZATION		3
CS ELECTIVE		3
FREE ELECTIVES		9
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 125 SEMESTER HOURS PLUS WELLNESS (2 HRS)

Electives

Wellness Elective

The 2-hour Wellness requirement may be fulfilled by either HPS 1040 or HPS 1061.

Humanities/Social Sciences Electives

ENGL 1101 and 1102 apply toward satisfaction of the 12-hour humanities requirement. An additional 6 hours of Institute-approved humanities courses are required to fulfill the 12-hour humanities requirement. To satisfy the state requirements regarding course work in the history and constitutions of the U.S. and Georgia, students must complete one of the following courses: HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200. One of these courses combined with an additional 9 hours of Institute-approved social science courses satisfy the 12-hour social sciences requirement.

Laboratory Science Electives

The laboratory science requirement may be fulfilled by CHEM 1211, BIOL 1501, EAS 1600, or EAS 1601.

Technical Electives and CS Areas of Specialization

Students are required to complete 12 hours of upper-division computer science technical electives, which include three areas of specialization. Students will be required to complete a major and two minor areas of specialization from the upper-division CS electives listed below. To complete the major area of specialization, students must complete two of the prescribed courses in one area. To complete a minor area of specialization, students must complete one course in each of two areas other than the major area of specialization. Additional computer science technical electives may be required to bring the total hours to 12. Students may petition to define other computer science areas of specialization to satisfy specific career objectives. A capstone design project is also required. Students satisfy this requirement by completing either CS 3351 (Studio Project), CS 3901 (Research Project), or CS 3911 (Design Project).

CS Specialization Courses

Each student must take at least two courses in one area and must take at least one course in each of two other areas (beyond the required courses).

Computer Systems

CS 3210 (2-3-3) Design of Operating Systems
CS 3220 (2-3-3) Computer Structures: Hardware/ Software Codesign of a Processor
CS 4210 (3-0-3) Advanced Operating Systems
CS 4220 (2-3-3) Programming Embedded Systems
CS 4230 (2-3-3) Distributed Simulation Systems
CS 4240 (3-0-3) Compilers, Interpreters, and Program Analyzers
CS 4290 (3-0-3) Advanced Computer Organization

Data Management Systems

CS 4400 (3-0-3) Introduction to Database Systems
CS 4420 (3-0-3) Database System Implementation
CS 4432 (2-3-3) Information Systems Design
CS 4440 (3-0-3) Emerging Database Technologies and Applications

Educational Technology
CS 4660 (3-0-3) Introduction to Educational Technology
CS 4670 (3-0-3) Computer Supported Collaborative Learning

Graphics and Visualization
CS 4451 (3-0-3) Computer Graphics
CS 4455 (3-0-3) Video Game Design and Programming
CS 4480 (3-0-3) Digital Video Special Effects
CS 4495 (3-0-3) Computer Vision
CS 4496 (3-0-3) Computer Animation

Intelligent Systems
CS 4495 (3-0-3) Computer Vision
CS 4600 (3-0-3) Introduction to Intelligent Systems
CS 4610 (3-0-3) Knowledge Systems
CS 4630 (3-0-3) Intelligent Robotics and Computer Vision
CS 4640 (3-0-3) Machine Learning
CS 4650 (3-0-3) Natural Language Understanding
CS 4752 (3-0-3) Philosophical Issues in Computation

Networking and Telecommunications
CS 3251 (3-0-3) Computer Networking I
CS 4251 (3-0-3) Computer Networking II
CS 4260 (3-0-3) Telecommunications Systems
CS 4270 (1-6-3) Data Communications Laboratory

Software Engineering
CS 3300 (2-3-3) Introduction to Software Engineering
CS 4320 (3-0-3) Introduction to Software Processes
CS 4330 (2-3-3) Software Engineering Applications

Theory
CS 4500 (3-0-3) Theory II
CS 6510 (3-0-3) Automata Theory
CS 6520 (3-0-3) Computational Complexity Theory
CS 6550 (3-0-3) Design and Analysis of Algorithms
CS 7510 (3-0-3) Graph Algorithms
CS 7520 (3-0-3) Approximation Algorithms
CS 7530 (3-0-3) Randomized Algorithms

Usability
CS 4470 (3-0-3) Introduction to User Interface Software
CS 4750 (3-0-3) Human-Computer Interface Design and Evaluation

CS Free Elective
A student may satisfy the three-hour computer science free elective requirement with one or more computer science courses that are not used to fulfill any other specific requirement. Credit hours in excess of three may be used as free elective hours.

Free Electives
Twenty-one hours of free elective courses may be taken at any time during the course of study. Four hours of basic ROTC may be used as free elective credit toward the bachelor's degree. If basic ROTC is selected to satisfy these credit hours, it must be scheduled beginning the first semester of the freshman year. No physical education hours may be used as free electives. No course that covers the same material as other courses in a student's plan of study can be used as a free elective.

Certificate in Information Systems
The Information Systems Certificate is offered jointly by the College of Computing and the DuPree College of Management. (Management students are eligible to obtain this certificate, but computer science students are not.) The focus of the certificate is in database and database management applications, but additional course work dealing with the management of software projects and data communications is included. More information on specific requirements may be obtained from the DuPree College of Management.

Graduate Programs

Master of Science in Computer Science
The program for the Master of Science in Computer Science (MSCS) prepares students for more highly productive careers in industry. Graduates receive the MSCS for completing one of three options in the program as described in this section. Students may apply to the program if they possess a bachelor's degree in computer science from an accredited institution. Students without a

bachelor's degree in computer science are encouraged to apply as well, with the understanding that they will be required to complete remedial course work appropriate to their background in addition to the requirements of the MSCS degree. Students who are currently graduate students in other programs at Georgia Tech may apply for permission to pursue the MSCS concurrently while completing their program in their main area of study. Students in other programs who wish to pursue this concurrent path must obtain permission in writing from the M.S. program coordinator prior to completing six hours of computer science courses. All applicants are evaluated according to their prior academic record, scores on the Graduate Record Examination and the Subject Test in Computer Science, a personal statement, and letters of recommendation. Applicants are selected for fall semester admission only. The application deadline is May 1. However, all applicants are encouraged to apply as early as possible because the selection process may begin well before the May 1 deadline.

The College's master's degree requirements supplement the Institute's master's requirements listed in this catalog. Students must achieve a grade point average of at least 3.0 to graduate, and no course grades below *C* will be allowed to count toward graduation. Undergraduate courses required for the BSCS degree may not be used toward the MSCS degree. In addition, no graduate credit will be given for 3000-level courses or lower-level courses. Students must take all master's degree course work on a letter-grade basis. The maximum total credit hours of Special Problems that may be applied toward the MSCS degree is three.

Students may choose from one of three options in pursuing the MSCS degree. These options are:

• **Course option** - This option requires the student to complete 36 hours of course work.

Total Course Credit Hours	36
Minimum Credit Hours in CS	24
Minimum Credit Hours (6000/8000 Level) in CS	18
Minimum Credit Hours (6000/8000 Level)	24

• **Project option** - This option requires the student to complete 27 hours of course work and a 9-hour project. The project requires approval by a faculty advisor and the M.S. coordinator in the semester prior to its inception.

Total Credit Hours	36
MS Project Hours	9
Total Course Credit Hours	27
Minimum Credit Hours in CS	24*
Minimum Credit Hours (6000/8000 Level) in CS	18*

• **Thesis option** - This option requires the student to complete 24 hours of course work and a 12-hour thesis. The thesis process is defined elsewhere in this catalog.

Total Credit Hours	36
MS Thesis Hours	12
Total Course Credit Hours	24
Minimum Credit Hours in CS	24*
Minimum Credit Hours (6000/8000 Level) in CS	18*

* May not include MS project or MS thesis hours.

All three of these options require students to complete three hours of courses in each of the core areas of Systems and Theory at the graduate level. In addition, students entering the program must demonstrate a core competency in computing equivalent to undergraduate-level courses in the following areas: systems, design and analysis of algorithms, formal languages and automata theory, databases, networking and communications, computer architecture, and human-computer interaction. This requirement can be satisfied by having taken undergraduate courses as a part of an undergraduate degree, taking remedial courses in the MSCS program, or by examination. Beyond the core requirements, students may specialize in areas of their choice. A specialization is achieved by completing at least 2 graduate-level courses in the selected area. Every student must complete at least one specialization as a part of his or her degree program. The current 10 specialization areas are: computer architecture, database, systems, graphics and visualization, human-computer interaction, intelligent systems, networking and communications, programming languages and compilers, software methodology and engineering, systems, and theoretical computer science.

A student who is enrolled in another graduate program of the Institute may pursue an MSCS while that student is also pursuing his or her degree in the other major. To be granted permission to pursue the MSCS, a student must submit to the M.S. Coordinator of the College of Computing the material required for admission to the MSCS program. This includes transcripts, letters of recommendation, and GRE General Test and Computer Science Subject Test Scores. If the student is approved by the College to pursue the MSCS, the student will be notified in writing. At no time will a student outside the College be allowed to pursue a concurrent degree without prior permission of the M.S. program coordinator of the College of Computing.

A student enrolled in the M.S. degree program in computer science who wishes to be admitted to the Ph.D. program in computer science should apply via the same process as external students. It is expected that such a student will have at least two letters of recommendation from College of Computing faculty.

Master of Science in Human-Computer Interaction

The Graphics, Visualization, and Usability (GVU) Center administers the Master of Science Program in Human-Computer Interaction (HCI). This interdisciplinary program is a cooperative effort of the College of Computing, the School of Psychology, and the School of Literature, Communication, and Culture. The HCI Master of Science program provides students with the practical interdisciplinary skills and theoretical understanding they will need to become leaders in the design, implementation, and evaluation of the computer interfaces of the future. Information about the HCI Master of Science program, including admissions applications, may be obtained by calling HCI Program Administration at (404) 894-4488 or by sending e-mail to: hci-ms@gvu.gatech.edu.

Master of Science in Bioengineering

Students who wish to pursue a master's degree in bioengineering may also do so through the College of Computing. The specific requirements differ from those of the computer science master's program, and while the degree is granted from the College, applications for this program are processed through the Bioengineering Center of the Office of Interdisciplinary Programs.

Interdisciplinary Certificate: Global Innovation for Engineers

During the M.S. program in Computer Science, students interested in global careers may obtain the Global Innovation for Engineers certificate. The requirements include a minor in management and international affairs and an internship working abroad. For further information, see: www.ece.gatech.edu/academic/gie.

Doctoral Program

The computer science doctoral program begins with research and breadth components. The research component helps students place an early focus on research. Students must complete an "Introduction to Graduate Studies" course (CS 7001) and then take at least three hours of directed research study (CS 8903) under faculty guidance each semester until their dissertation. The breadth component is intended to facilitate students' learning about a variety of areas within computing, as well as core computer science areas. Students must take at least one course per semester for their first five semesters from a different area of study within the College. The current ten areas are computer architecture, database systems, graphics and visualization, human-computer interaction, intelligent systems and robotics, networking and communications, programming languages and compilers, software methodology and engineering, systems (including operating systems, distributed and parallel systems), and theoretical computer science. Students must include courses from the systems and theory areas in those five semesters.

As students' research progresses, they must select a primary, and possibly secondary, area of focus from the list of areas above, and then pass a Qualifier (Comprehensive Exam) in that area or areas. The Qualifier consists of three parts:

1. A one-day written examination covering the pertinent research area(s);
2. The submission of a high-quality research deliverable, as evidenced by a portfolio consisting of at least an exam committee-

reviewed and publishable article, and possibly other work products as approved by the exam committee; and

3. An oral presentation and examination.

After successfully completing the Qualifier, a student focuses on research leading toward a dissertation. The topic of the student's research is formalized through a written dissertation proposal followed by an oral presentation. When the student passes his or her proposal, the student is admitted to candidacy and proceeds with dissertation research. This phase is completed with the successful defense and submission of the approved doctoral dissertation.

Students are also required to complete a nine-hour minor outside the College.

Further details about the degree program can be found at: www.cc.gatech.edu/student.services/phd. Inquiries should be directed to the Graduate Coordinator, College of Computing.

Cognitive Science

Doctoral students desiring to approach their graduate studies from the perspective of cognitive science are encouraged to obtain a Certificate in Cognitive Science in addition to the doctoral degree. Interested students will receive their degree from one of the participating units and follow an interdisciplinary curriculum tailored to their specific interests in cognitive science. Although doctoral students from any unit on campus may receive a Certificate in Cognitive Science, the program is currently tailored to doctoral students in the College of Computing, the School of Psychology, and the School of Industrial and Systems Engineering. Students enter the certificate program after being admitted to one of the doctoral programs of the Institute.

In order to earn the Certificate of Cognitive Science, students fulfill the doctoral requirements in some unit of the Institute, have at least two members of their dissertation advisory committee from faculty affiliated with the cognitive science program, and take a series of core cognitive science courses consisting of at least three introductory cognitive science disciplinary courses, one methodology course outside their home discipline, a minimum of four topical courses and/or seminars, and participation in the continuing "Colloquium in Cognitive Sciences" (CS 8795). Inquiries concerning this program may be directed to the Office of Student Services, College of Computing.

Algorithms, Combinatorics, and Optimization (ACO)

The College of Computing is one of the sponsors of the multidisciplinary program in Algorithms, Combinatorics, and Optimization (ACO), an approved doctoral degree program at Georgia Tech. The other sponsoring units are the School of Industrial and Systems Engineering and the School of Mathematics. The degree program is administered by an oversight committee drawn primarily from the sponsoring units.

The study of discrete structures is a rapidly growing area in computer science, applied mathematics, and operations research, most obviously in the analysis of algorithms, combinatorics, and discrete optimization. Collaborative work among the three traditionally separate disciplines is already common. The doctorate in algorithms, combinatorics, and optimization will prepare students for careers in this exciting and expanding new field.

Students are expected to be well prepared in at least one of the three fields represented by the sponsoring units (computer science, mathematics, and operations research). Each student in the program is admitted through one of the three sponsoring units, which serves as the home department. Course work is drawn from all three disciplines. The research advisor may be any member of the ACO program faculty, which is drawn from electrical and computer engineering, management, and other disciplines in addition to the three sponsoring units.

Bioengineering

In response to the increased need for engineers and medical scientists with advanced training in bioengineering, Georgia Tech now offers master's and Ph.D. degrees in bioengineering. The purpose of bioengineering as a research discipline is to develop new and better physical and mathematical concepts and techniques that may be applied to problems in medicine and biology, to the development of new medical technologies, and to the organization and delivery of cost-effective health care. Interdisciplinary graduate programs in bioengineering are offered by the College of Computing in conjunction with the Bioengineering Center (in the Office of Interdisciplinary Programs), the College of Engineering, and the College of Sciences. The student's home unit will be the College of Computing, which, upon completion of the student's requirements, will recommend the degree. This interdisciplinary approach has been approved by the faculty in the schools of Aerospace Engineering, Chemical Engineering, Electrical and Computer Engineering, Materials Science and Engineering, Mechanical Engineering, and Textile and Fiber Engineering, and by the deans of the colleges of Computing, Engineering, and Sciences.

The program is for computer science or engineering graduates who wish to pursue a degree in bioengineering rather than in a traditional field of computing or engineering, or who have done bioengineering research in other disciplines. In addition, those interested students with nonengineering backgrounds (with degrees in such fields as physics, chemistry, biology, or mathematics) who meet the admission requirements will be admitted to the program. Applications from physicians with undergraduate degrees in engineering or the physical sciences will also be considered. All applications will be processed through the Bioengineering Center.

Research Centers in the College of Computing

Broadband Telecommunications Center

The Broadband Telecommunications Center explores the technology required to bring advanced interactive services to the home and the applications that will exploit this technology.

Today, digital communication to the home is very limited. Low communication rates can be achieved by digital modems, but they greatly limit the types of services that can be offered. There is, however, emerging technology that offers large digital capacity to every home, completing the final link to the information highway. Some examples of services that can be provided are distance learning, community information services, and entertainment services such as interactive games. Most of the technology required to provide these services already exists. The challenge is to provide complete scaleable systems inexpensively. Much invention and innovation is needed to supply missing pieces of specific technologies and to compare the effectiveness of different approaches.

Researchers at Georgia Tech are active in exploring technology for the delivery of services. Examples are: data over cable, linear optical modulation, blind equalization, and video servers. The program is divided into five areas: Applications; Business and Economic Issues; Systems and Software; Networking; and Physical Layer. At the moment, there are approximately 15 faculty active in this program within computer science and electrical engineering. Students at both the undergraduate and graduate levels may participate through special topics classes in computer science and electrical engineering. For more information, contact the BTC office at (404) 894-1404.

Within Georgia Tech, the Center is supported by the College of Computing, the School of Electrical and Computer Engineering, and the Georgia Tech Research Institute.

The EduTech Institute

The EduTech Institute was created in 1993, when the Woodruff Foundation awarded funds to Georgia Tech to investigate the application of technology to enhancing and facilitating scientific and technological education. Its primary focal areas are design and science education. EduTech's efforts are guided by the knowledge of the cognition of learning, problem solving, and understanding.

EduTech uses technology to ensure that education in these areas is relevant and effective for all students (not just those for whom learning comes easily), and prepares them for the complexities of the environments they will encounter as they enter the workplace. EduTech's projects include new curricula, teaching styles and guidelines, classroom activities, and software—all tried and assessed in a variety of education situations.

EduTech aims to make educational advances in several specific areas: making science education relevant and engaging; educating students for a lifetime of learning; educating engineers for the workplace of the future; and supporting team activities (especially over distances and developing improved forms of assessment of educational innovations). Advances in such areas will allow great strides in educating students to be productive members of modern society.

Georgia Tech Information Security Center (GTISC)

The Information Security Center conducts interdisciplinary research and development focusing on all aspects of information security. The primary emphasis is on developing new technologies and methods for ensuring security of information, including systems-level vulnerability assessment and theory development. A strong secondary emphasis is on public and organizational security policies.

Graphics, Visualization, and Usability (GVU) Center

The GVU Center is an interdisciplinary teaching and research center housed in the College of Computing. Through education, research, and service, the GVU Center is working toward its vision of a society in which computers are as commonplace and accessible as the telephone or automobile.

In GVU's educational role, its multidisciplinary faculty teach the principles and methods of graphics, visualization, user interface design, and usability to members of the academic community ranging from undergraduate and graduate students to other faculty. The GVU Center is not an academic unit in and of itself; its students are drawn from campus units as diverse as Architecture; Computing; Engineering; Literature, Communication, and Culture; Psychology; and others.

Research projects are as varied as the academic units affiliated with GVU, and the interdisciplinary focus encourages fresh perspectives and innovative approaches. The Center also has established a usability testing lab in which real users can "test drive" new interfaces, and maintains close relationships with industry in an effort to keep its research on track and relevant to real-life problems.

GVU's service mission is carried out through the Scientific Visualization Lab, a joint undertaking with the Office of Information Technology, which provides state-of-the-art computer graphics hardware and software capabilities to the entire university. More than 600 faculty, staff, and students use the lab's facilities. The SciVis Lab regularly sponsors seminars for members of the Georgia Tech community to familiarize them with new equipment and software.

For more information about the GVU Center, contact the Office of Student Services, College of Computing, and request a GVU brochure, or browse the GVU website at www.cc.gatech.edu/gvu/.

Cooperative Programs

Undergraduate and Graduate Cooperative Program

The College participates in the Undergraduate and Graduate Cooperative Programs. Further details of the Undergraduate and Graduate programs are found in this *Catalog* in the section "Information for Undergraduate Students" and "Information for Graduate Students."

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

COMPUTER SCIENCE

CS 1050. Understanding and Constructing Proofs
3-0-3.
Techniques of rigorous argumentation, emphasizing reading and writing of formal and informal proofs. Application of techniques to domains of relevance to computer science.

CS 1301. Computer Science I
2-3-3.
Foundations of computing with an emphasis on the design, construction, and analysis of algorithms. Laboratory-based introduction to computers and software tools.

CS 1302. Computer Science II
2-3-3. Prerequisite(s): CS 1301
Techniques and practices for implementing algorithms. Emphasis on professional software practices. Project focus on interactive and computationally intensive programs, including large program management.

CS 1801-2,-3,-4,-5. Special Topics
Credit and class hours equal last digit in the course number.
Courses of timely interest to the profession, conducted by resident or visiting faculty.

CS 2200. Computer Systems and Networks
3-3-4. Prerequisite(s): CE 2030 and CS 2330.
A broad exposure to computer system structure and networking including software abstractions in operating systems for orchestrating the usage of the computing resources.

CS 2330. Languages and Translation
3-0-3. Prerequisite(s): CS 1302; Co-requisite: CS 2331
Machine translation in the context of learning imperative programming. Covers tokenizing, parsing, machine representations of high-level data, scoping, and functions. Introduces functional programming.

CS 2331. Programming Practicum I
1-3-2. Co-requisite: CS 2330.
Methods for solving large programming problems. Techniques for debugging, quality assurance, and managing large programs. Tools for program construction.

CS 2340. Objects and Design
3-0-3. Prerequisite(s): CS 2330; Co-requisite: CS 2341.
Object-oriented programming methods for dealing with large programs. Focus on quality process, effective debugging techniques,and testing to assure a quality product.

CS 2341. Programming Practicum II
1-3-2. Co-requisite: CS 2340.
Methods for solving complex, ill-structured problems using object-oriented software process. Techniques for working in teams, analyzing problems, and producing effective solutions.

CS 2600. Knowledge Representation and Processing
3-3-4. Prerequisite(s): CS 1302
Introduction to the representation and manipulation of complex symbolic and sub-symbolic information.

CS 2801,-2,-3,-4,-5. Special Topics
Credit hours equal last digit in course number.
Courses of timely interest to the profession, conducted by resident or visiting faculty.

CS 3210. Design of Operating Systems
2-3-3. Prerequisite(s): CS 2200.
Operating systems concepts, including multi-threading, scheduling, synchronization, communication, and access control. Projects will cover design and implementation of several operating systems components.

CS 3220. Computer Structures: Hardware/Software Codesign of a Processor
2-3-3. Prerequisite(s): CS 2200 and CS 2330
Principles in pipelined processor design, with emphasis on the need for a close interaction between code generation and architecture.

CS 3251. Computer Networking I
3-0-3. Prerequisite(s): CS 2200.
Introduction to problems in computer networking, including error recovery, medium access, routing, flow control, and transport. Emphasis on current best practice. Includes programming of networked applications.

CS 3300. Introduction to Software Engineering
2-3-3. Prerequisite(s): CS 2330 and CS 2340.
Team-based project class to introduce and apply software engineering principles and practices.

CS 3351. Studio Project
1-6-3. Prerequisite(s): CS 2341 and CS 3300.
A project-oriented laboratory course used to familiarize students with software engineering methods in a realistic environment.

CS 3352. Studio Project
1-6-3. Prerequisite(s): CS 3351
A project-oriented laboratory course used to familiarize students with software engineering methods in a realistic environment.

CS 3353. Studio Project
1-6-3. Prerequisite(s): CS 3352
A project-oriented laboratory course used to familiarize students with software engineering methods in a realistic environment.

CS 3500. Theory I
4-0-4. Prerequisite(s): CS 1050 and CS 1302; Co-requisite: MATH 3012.
Computational machine models and their language classes. Decidability and undecidability. Data structures and efficient algorithms for fundamental computational problems. Tractability and intractability.

CS 3790. Introduction to Cognitive Science
3-0-3.
Multidisciplinary perspectives on cognitive science. Interdisciplinary approaches to issues in cognition, including memory, language, problem solving, learning, perception, and action. Crosslisted with PST, PSYC, and ISYE 3790.

CS 3801,-2,-3,-4,-5. Special Topics
Credit hours equal the last digit of course number.
Courses of timely interest to the profession, conducted by resident or visiting faculty.

CS 3901,-2,-3. Research Project
Credit hours to be arranged
Individual investigation of significant areas of computer science. Guided study and research.

CS 3911,-2,-3. Design Project
Credit hours to be arranged. Prerequisite(s): CS 2341 and CS 3911, CS 3912, respectively.
Intensive team-based project experience in the specification, design, and implementation of software and/or hardware for subsequent use in research, industry, and teaching.

CS 4000. Computerization in Society
2-0-2. Co-requisite: LCC 3400.
Examines computing as a social process with emphasis on ethical issues and the social impact of computerization on local and global organizations.

CS 4010. Introduction to Computer Law
3-0-3.
Provides an introduction to copyrights, patents, trade secrets, trademarks, and commercial law pertaining to computer software and hardware.

CS 4210. Advanced Operating Systems
3-0-3. Prerequisite(s): CS 3210
Operating system abstractions and their implementations, multi-threading, efficient inter-address communication, high-level synchronization, introduction to multiprocessor and distributed operating systems, real-time systems.

CS 4220. Programming Embedded Systems
2-3-3. Prerequisite(s): CS 2200 and CS 2330 and ECE 2030
Design principles, programming techniques, and case studies of embedded real-time systems. Interface techniques and devices. Representations and reasoning about physical processes.

CS 4230. Distributed Simulation Systems
2-3-3. Prerequisite(s): CS 2200
Parallel and distributed computing algorithms and systems for distributed simulation applications such as virtual environments and analytic models.

CS 4240. Compilers, Interpreters, and Program Analyzers
3-0-3. Prerequisite(s). CS 2330
Study of techniques for the design and implementation of compilers, interpreters, and program analyzers, with consideration of the particular characteristics of widely used programming languages.

CS 4251. Computer Networking II
3-0-3. Prerequisite(s): CS 3251
Principles of computer networks, including medium access, ARQ protocols, routing, congestion avoidance and control. Emphasis on design options and tradeoffs. Includes significant network application programming.

CS 4260. Telecommunications Systems
3-0-3. Prerequisite(s): CS 2200 and MATH 4215
Study of telecommunication systems emphasizing functional roles of the various portions of the system and how various functional components support and interact with one another.

CS 4270. Data Communications Laboratory
1-6-3. Prerequisite(s): CS 3251 and CS 4260; Co-requisite: CS 4251.
Detailed study of the principles of data transmission systems and their performance, reinforced by laboratory exercises.

CS 4280. Survey of Telecommunications and the Law
3-0-3.
Overview of telecommunication regulation at the federal, state, and judicial levels; review of FCC policies and restrictions on Bell operating companies under the AT&T Consent Agreement.

CS 4290. Advanced Computer Organization
3-0-3. Prerequisite(s): CS 2200
Topics concerning the hardware design of computer systems. Advanced techniques in high-performance pipelined central processing units. Memory and I/O systems. Parallel processors including shared-memory multiprocessors and cluster computers.

CS 4320. Introduction to Software Processes
3-0-3. Prerequisite(s) CS 3351
The course will provide students with an overall context in which software systems are developed from the viewpoint of processes that support the development. Software engineering is described as the set of activities developers engage in to create high-quality products within schedule and budget contraints

CS 4330. Software Engineering Applications
2-3-3. Prerequisite(s): CS 3351
Software engineering methods specific to classes of application or system, including information systems and embedded, real-time systems.

CS 4400. Introduction to Database Systems
3-0-3. Prerequisite(s): CS 2330.
Comprehensive coverage of mainstream database concepts such as the entity-relationship model, relational databases, query languages, and database design methodology. Includes a project.

CS 4420. Database System Implementation
3-0-3. Prerequisite(s): CS 4400.
Study of fundamental software components/algorithms of a database system, including the file manager, query engine, lock manager, and recovery manager Includes a project component.

CS 4432. Information Systems Design
2-3-3. Prerequisite(s): CS 4320.
The analysis, design, and implementation of information systems. Topics include requirements analysis, design representations, implementation techniques, and evaluation of systems.

CS 4440. Emerging Database Technologies and Applications
3-0-3. Prerequisite(s): CS 4400
The course will cover current developments including distributed, object-oriented, temporal-spatial, web-based, mobile, and active database technologies, and data warehousing and mining applications.

CS 4451. Computer Graphics
3-0-3. Prerequisite(s): MATH 2601 and CS 2330
An introduction to computer graphics, including: graphics hardware, 2D rendering, 2D and 3D transformations, visible surface determination, illumination, modeling, and ray tracing.

CS 4455. Video Game Design and Programming
3-0-3. Prerequisite(s): CS 1302
Techniques for electronic game design and programming, including graphics game engines, motion generation, behavioral control for autonomous characters, interaction structure, social and interface issues of multi-user play, and the business aspects of game development.

CS 4470. Introduction to User Interface Software
3-0-3. Prerequisite(s): CS 2340 and (CS 4750 or PSYC 4750)
Concepts, techniques, structures, and strategies for implementation of interactive software.

CS 4480. Digital Video Special Effects
3-0-3. Prerequisite(s): CS 1302
A study of digital multimedia and the analysis and synthesis of digital video. Special attention paid to techniques for generating video special effects.

CS 4495. Computer Vision
3-0-3. Prerequisite(s): CS 4630
An introduction to computer vision and machine perception. An intensive study of the process of generating a symbolic description of the scene by interpretation of images(s).

CS 4496. Computer Animation
3-0-3. Prerequisite(s): CS 4451 or CS 6490
Motion techniques for computer animation and interactive games (keyframing, procedural methods, motion capture, and simulation) and principles for storytelling, composition, lighting, and interactivity.

CS 4500. Theory II
3-0-3. Prerequisite(s): CS 3500
Sample topics include cryptography, pseudorandomness, approximation algorithms, randomized algorithms, complexity, parallel algorithms, distributed protocols, information theory, coding theory, and computational geometry.

CS 4600. Introduction to Intelligent Systems
3-0-3. Prerequisite(s): CS 2340
An introduction to artificial intelligence, cognitive science, vision, and robotics. Topics covered include intelligent system design methodologies, machine problem solving, learning and perception, robotics, and cognitive modeling.

CS 4610. Knowledge Systems
3-0-3. Prerequisite(s): CS 4600
Knowledge-based problem solving and knowledge system engineering. Topics include expert systems, knowledge acquisition, problem solving, and explanation.

CS 4630. Intelligent Robotics and Computer Vision
3-0-3. Prerequisite(s): CS 4600
Methodologies for embedding artificial intelligence in robotics systems. Assembly planning, autonomous navigation, learning, and visual processing are among the topics that will be covered.

CS 4640. Machine Learning
3-0-3. Prerequisite(s): CS 4600
Machine learning techniques and applications. Topics include foundational issues; inductive, analytical, analogical, numerical, subsymbolic, and theoretical approaches; and real-world applications.

CS 4650. Natural Language Understanding
3-0-3. Prerequisite(s): CS 4600
Methodologies for designing systems that comprehend natural language. Topics include lexical analysis, parsing, interpretation of sentences, semantic representation, organization of knowledge, and inference mechanisms.

CS 4660. Introduction to Educational Technology
3-0-3. Prerequisite(s): CS 2340.
Introduction to the theory and practice of educational technology. Covers learning theory applicable to educational technology, explains major research findings.

CS 4670. Computer-Supported Collaborative Learning
3-0-3. Prerequisite(s): CS 4660
Research and practice in computer-supported collaborative learning. Review of existing systems and research, as well as evaluation and design methods.

CS 4750. Human-Computer Interface Design and Evaluation
3-0-3.
Human-computer interface is considered in terms of user-system compatibility. Concepts in human factors and interface design are covered in relation to capabilities of both humans and computers. Crosslisted with PSYC 4750.

CS 4752. Philosophical Issues in Computation
3-0-3.
Metaphysical and epistemological issues in the foundations, methods, and implications of computing. Issues include: minds, brains, and machines; representation and language; simulating nature. Crosslisted with PST 4752.

CS 4761. Models of Human Information Processing
3-0-3. Prerequisite(s): PSYC 1101
General and unified approaches to psychological and computer modeling of human information processing. Crosslisted with PSYC 4761.

CS 4777. Vector and Parallel Scientific Computing
3-0-3. Prerequisite(s): MATH 2502
Scientific computational algorithms on vector and parallel computers. Speedup, algorithmic complexity, interprocess communication, synchronization, modern algorithms for linear systems, programming techniques, code optimization. Crosslisted with MATH 4777.

CS 4790. Seminar in Cognitive Science
3-0-3.
A seminar-type course in cognitive science focusing on integrating and deepening students' cognitive science knowledge and skills. Topics include memory, language, problem solving, learning, perception, and action. Crosslisted with PST, PSYC, and ISYE 4790.

CS 4791. Integrative Project in Cognitive Science
3-0-3.
An integrative course in cognitive science focusing on the integration and use of concepts and skills from cognitive science. A different integrative project or set of projects will be taken on each semester; students will contribute on the basis of their background and skill. Crosslisted with PST, PSYC, and ISYE 4791.

CS 4792. Design Project in Cognitive Science
3-0-3.
Individual project with a cognitive science faculty member, designed as a supplement to the student's senior design project or thesis in their major area. Crosslisted with PST, PSYC, and ISYE 4792.

CS 4801,-2,-3,-4,-5. Special Topics
Credit hours equal the last digit in the course number.
Courses of timely interest to the profession, conducted by resident or visiting faculty.

CS 4901,-2,-3. Special Problems
Credit hours to be arranged
An investigation of significant areas of information in computer science. Guided study and research.

CS 6010. Principles of Design
2-3-3.
This is an interactive hands-on course that will teach students the principles of design at the individual level.

CS 6210. Advanced Operating Systems
3-0-3. Prerequisite(s): CS 3210
Introduction to graduate-level topics in operating systems, using research papers, textbook excerpts, and projects. Provides students thorough comprehension of distributed and parallel computer systems.

CS 6230. High-Performance Parallel Computing: Tools and Applications
3-0-3. Prerequisite(s): CS 3210
Introduction to MIMD parallel computation, using textbook excerpts, research papers, and projects on multiple parallel machines. Emphasizes practical issues in high-performance computing.

CS 6235. Real-Time System Concepts and Implementation
3-0-3. Prerequisite(s): CS 3210
Principles of real-time systems, as occurring in robotics and manufacturing, interactive and multimedia applications. Reviews and uses real-time operating systems.

CS 6236. Parallel and Distributed Simulation Systems
3-0-3. Prerequisite(s): CS 3210
Algorithms and techniques used in parallel/distributed discrete event simulation systems. Synchronization algorithms, data distribution, applications to high-performance analytic simulations and distributed virtual environments.

CS 6241. Design and Implementation of Compilers
3-0-3. Prerequisite(s): CS 4240
Design and inplementation of modern compilers, focusing on optimization and code generation.

CS 6245. Compiling for Parallelism
3-0-3. Prerequisite(s): CS 4240
Design and implementation of compilers for parallel and distributed computers, focusing on optimization and code generation.

CS 6250. Computer Networks
3-0-3.
Principles and practice of computer networks, including signaling and framing, error control, medium access, routing, congestion control, end-to-end transport, and network APIs.

CS 6280. Performance Evaluation of Communication Networks
3-0-3. Prerequisite(s): CS 6250 and MATH 4215
Methods for evaluating the performance of communication networks with emphasis on modeling, mathematical analysis, computer simulation, and measurement.

CS 6290. High-Performance Computer Architecture
3-0-3. Prerequisite(s): CS 2200
Topics concerning very high-performance computers including techniques exploiting parallelism in single and multiple processor systems. Credit not given for both CS 4290 and 6290.

CS 6300. Software Development Process
3-0-3.
The process of developing software systems. Includes development and assessment of processes, their instantiation in actual product development, and techniques ensuring quality of developed products.

CS 6310. Software Architecture and Design
3-0-3. Prerequisite(s): CS 6300
Principles and concepts involved in the design and analysis of large software systems.

CS 6320. Software Requirements Analysis and Specification
3-0-3. Prerequisite(s): CS 6300
Methods and principles for determining, documenting, analyzing, and formally specifying requirements for software systems.

CS 6330. Software Generation, Testing, and Maintenance
3-0-3. Prerequisite(s): CS 6300
Introduction to methods and principles for programming, testing, and managing the evolution of software systems.

CS 6390. Programming Language Design
3-0-3.
Design, structure, and goals of programming languages. Object-oriented, logic, functional, and traditional languages. Semantic models. Parallel programming languages.

CS 6400. Database Systems Concepts and Design
3-0-3. Prerequisite(s): CS 4400
Study of fundamental concepts with regard to relational databases. Topics covered include database design, query processing, concurrency control and recovery.

CS 6411. Object-Oriented Database Models and Systems
3-0-3. Prerequisite(s): CS 6400
Study of advanced database concepts as they apply to object-oriented database systems. Topics include semantic data models, object-oriented query languages, tools and applications.

CS 6421. Active and Dynamic Database Management Systems
3-0-3. Prerequisite(s): CS 6400
Study of advanced database concepts for temporal databases with emphasis on storage structure, processing, and query languages, as well as active database concepts and implementation.

CS 6430. Parallel and Distributed Database Systems and Applications
3-0-3. Prerequisite(s): CS 4420 or CS 6400
Study of algorithms and performance in advanced databases. Systems include parallel, distributed, and client-server databases. Applications include data mining and on-line analytical processing.

CS 6455. User Interface Design and Evaluation
3-0-3. Prerequisite(s): CS 6750 or PSYC 6750
Examines usability in the software development process with an emphasis on usability, requirements, methodology, design, and evaluation.

CS 6456. Principles of User Interface Software
3-0-3. Prerequisite(s): CS 6750 or PSYC 6750
Considers the architectural and algorithmic principles behind the implementation of interactive software systems and the tools that support them.

CS 6460. Educational Technology: Design and Analysis
3-0-3.
Issues, design techniques, and analysis methods for educational technology.

CS 6480. Computer Visualization Techniques
3-0-3. Prerequisite(s): CS 4451
Principles, techniques, and practice in data, information, multivariate, and scientific visualization. Includes visualization methods, data structures, examples, and tools.

CS 6485. Visualization Methods for Science and Engineering
3-0-3. Prerequisite(s): CS 4451
Algorithms, software, and practical applications of visualization techniques in science, engineering, business, and medicine. Includes data structures, multivariate visualization, interactive visualization, and visual representations and examples. Computer science students cannot receive credit for this course.

CS 6490. 3D Modeling and Graphics
3-0-3. Prerequisite(s): CS 4451
Course teaches expertise in 3D modeling and graphics, problem-solving skills, and advanced data structures and algorithms for representing, transmitting, rendering, and animating complex 3D scenes.

CS 6500. Introduction to Algorithms
3-0-3. Prerequisite(s): CS 3500
Basic techniques of design and analysis of efficient algorithms for standard computational problems. Not appropriate for Ph.D. students.

CS 6510. Automata Theory
3-0-3.
Study of the significant results concerning finite automata, pushdown automata, and Turing machines, and their associated language classes.

CS 6520. Computational Complexity Theory
3-0-3. Prerequisite(s): CS 3500
Introduction to resource-bounded computations, central complexity-theoretic concepts such as complexity classes, reducibility, completeness, and intractability.

CS 6550. Design and Analysis of Algorithms
3-0-3. Prerequisite(s): CS 3500
Advanced techniques for designing and analyzing efficient algorithms for combinatorial, algebraic, and number-theoretic problems.

CS 6610. Cognitive Systems
3-0-3. Prerequisite(s): CS 4600
Concepts, theories, and designs of cognitive systems. Topics include problem solving, learning, knowledge representation, knowledge systems, and cognitive interfaces.

CS 6660. Intelligent Agents
3-0-3. Prerequisite(s): CS 4600
Concepts, theories, designs, and implementations of intelligent hardware and software agents. Topics include action selection, planning, learning, user modeling, agent-human interaction, and multi-agent systems.

CS 6670. Distributed Control Algorithms
3-0-3. Prerequisite(s): CS 4600
Algorithms for synchronous, asynchronous, and partially synchronous networks; analysis, control, and implementation of distributed systems such as robot fleets, animal groups.

CS 6705. Applications of Artificial Intelligence
3-0-3.
A study of the principles and practice of artificial intelligence in areas other than computer science, with particular focus on engineering, science, and business applications. Computer science majors cannot receive credit for this course.

CS 6750. Human-Computer Interaction
3-0-3.
Describes the characteristics of interaction between humans and computers and demonstrates techniques for the evaluation of user-centered systems. Crosslisted with PSYC 6750.

CS 6780. Medical Image Processing
3-0-3. Prerequisite(s): EE 6391
A study of methods for enhancing, analyzing, interpreting, and visualizing information from two- and three-dimensional data obtained from a variety of medical image modalities. Crosslisted with ECE and BMED 6780.

CS 6795. Introduction to Cognitive Science
3-0-3.
Multidisciplinary perspectives on cognitive science. Interdisciplinary approaches to issues in cognition, including memory, language, problem solving, learning, perception, and action. Crosslisted with ISYE and PSYC 6795.

CS 7000. Master's Thesis
Credit hours to be arranged

CS 7001. Overview of Graduate Studies in Computing
3-6-5.
Research tools including computer systems, as well as fundamental problem-solving skills are introduced. Lectures on current computing research are presented, and projects are required. Credit not allowed in a program of study for a graduate degree.

CS 7110. Parallel Computer Architectures
3-0-3. Prerequisite(s): CS 6290
Issues in the design, implementation, and programming of parallel machines.

CS 7210. Distributed Computing
3-0-3. Prerequisite(s): CS 6210
Fundamental concepts in distributed systems, including global states, logical clocks, and failure models. Distributed algorithms and their implementations using advanced distributed programming systems.

CS 7230. Systems Software Design, Implementation, and Evaluation
1-6-3. Prerequisite(s): CS 4240 and CS 6210
Design, implementation, and evaluation of systems software. Distributed/parallel applications will be constructed and evaluated using the systems support that is developed.

CS 7250. Broadband Networking Systems
3-0-3. Prerequisite(s): CS 6250
Focus on the data link layer and its relationship to layers below and above. Gigabit Ethernet, SONET, fibre channel; media including wireless, satellite, xDSL, cable.

CS 7260. Internetworking Architectures and Protocols
3-0-3. Prerequisite(s): CS 6250
Detailed discussion of the problems and solution techniques that arise in internetworking. Topics include routing, addressing, quality of service, and security.

CS 7270. Networked Applications and Services
3-0-3. Prerequisite(s): CS 6250
End-to-end functional building blocks and their use in adaptive and non-adaptive applications, including multimedia: coding, compression, security, directory services.

CS 7450. Information Visualization
3-0-3. Prerequisite(s): CS 6456
Study of computer visualization principles, techniques, and tools used for explaining and understanding symbolic, structured, and/or hierarchical information. Includes data and software visualization.

CS 7460. Collaborative Computing
3-0-3. Prerequisite(s): CS 6750 or PSYC 6750
Introduction to computer-supported collaborative work, workflow automation, and meeting augmentation. The course deals with models, enabling technology, systems, and applications.

CS 7470. Mobile and Ubiquitous Computing
3-0-3. Prerequisite(s): CS 6750 or PSYC 6750
Investigates the infrastructure required to develop mobile and ubiquitous computing applications and establishes major research themes and experimental practices.

CS 7495. Computer Vision
3-0-3. Prerequisite(s): CS 4630
An introduction to computer vision and machine perception. An intensive study of the process of generating a symbolic description of the scene by interpretation of images(s).

CS 7496. Computer Animation
3-0-3. Prerequisite(s): CS 4451 or CS 6490
Motion techniques for computer animation and interactive games (keyframing, procedural methods, motion capture, and simulation) and principles for storytelling, composition, lighting, and interactivity

CS 7497. Virtual Environments
3-0-3. Prerequisite(s): CS 4451 or CS 6490
An introduction to virtual reality and virtual environments. Issues covered will include VR technology, software design, 3D human-computer interaction, and applications of VR.

CS 7510. Graph Algorithms
3-0-3. Prerequisite(s): CS 6500 or CS 6550
Algorithms for graph problems such as maximum flow, matching, network reliability, and minimum cuts.

CS 7520. Approximation Algorithms
3-0-3. Prerequisite(s): CS 6500 or CS 6550
Approximation algorithms for NP-hard optimization problems, design and analysis techniques for such algorithms.

CS 7530. Randomized Algorithms
3-0-3. Prerequisite(s): CS 6500 or CS 6550
Techniques for designing and analyzing randomized algorithms, derandomization techniques.

CS 7610. Modeling and Design
3-0-3. Prerequisite(s): CS 6610
Information-processing theories of modeling and design; topics include design decision making, problem solving and learning, and knowledge-based modeling and design.

CS 7615. Knowledge Agents
3-0-3. Prerequisite(s): CS 6660
Knowledge-based interactive systems, knowledge-based autonomous agents, agent architectures, learning and adaptation, agent evolution.

CS 7620. Case-Based Reasoning
3-0-3. Prerequisite(s): CS 6610
Topics include case representation, indexing and retrieval, adaptation, interpretive CBR, the cognitive model that CBR implies, and its implications for creativity, decision aiding, and education.

CS 7630. Autonomous Robotics
3-0-3. Prerequisite(s): CS 4600
The principles and practice of autonomous robotics including behavior-based design and architectures, adaptive learning and team behavior, and the role of perception within robotic systems.

CS 7635. Computational Perception
3-0-3. Prerequisite(s): CS 4630
Study of methods for extraction and interpretation of perceptual/sensory signals. Topics include techniques for face, gesture, and speech recognition from audio and video.

CS 7640. Learning in Autonomous Agents
3-0-3. Prerequisite(s): CS 4640 or CS 6610 or CS 6660
An indepth look at agents that learn, including intelligent systems, robots, and humans. Design and implementation of computer models of learning and adaptation in autonomous intelligent agents.

CS 7645. Numerical Machine Learning
3-0-3. Prerequisite(s): CS 4640
This course explores problems in classification/pattern recognition (OCR, speech, vision, fault detection, medical diagnosis), regression/function approximation, robot control, and reinforcement learning.

CS 7695. Philosophy of Cognition
3-0-3.
Examines problems in the foundations of cognition in relation to current issues in cognitive sciences. Topics include meaning, mental imagery, consciousness, and mind/body problem.

CS 7696. Cognitive Models of Science
3-0-3.
Examines how models of reasoning and representation that are developed in the cognitive sciences can provide the basis for an enriched understanding of scientific theories and practices.

CS 7790. Cognitive Modeling
2-6-4. Prerequisite(s): CS 6795 or ISYE 6795 or PSYC 6795
A hands-on course covering a range of cognitive modeling methodologies. It explores the analysis, development, construction, and evaluation of models of cognitive processing. Crosslisted with ISYE and PSYC 7790.

CS 7999. Preparation for Doctoral Qualifying Exams
Credit hours to be arranged. Prerequisite: consent of the College.

CS 8001,-2,-3,-4,-5,-6. Seminar
Credit hours equal the last digit of course number.
Group discussion of advanced topics in information and computer science. No credit toward the CS M.S. degree.

CS 8030. Software Engineering Seminar
1-0-1.
This seminar provides students with an opportunity to explore contemporary topics in software engineering.

CS 8795. Colloquium in Cognitive Sciences
1-0-1.
Reading of research papers by leading cognitive scientists, attendance at their colloquia, and meeting with them to discuss research. Crosslisted with ISYE and PSYC 8795.

CS 8801,-2,-3,-4,-5,-6. Special Topics
Credit hours equals last digit of course number.
Special topics of current interest. Treatment of new developments in various areas of computing.

CS 8890. Special Topics in Cognitive Science
3-0-3.
Special topics of current interest.

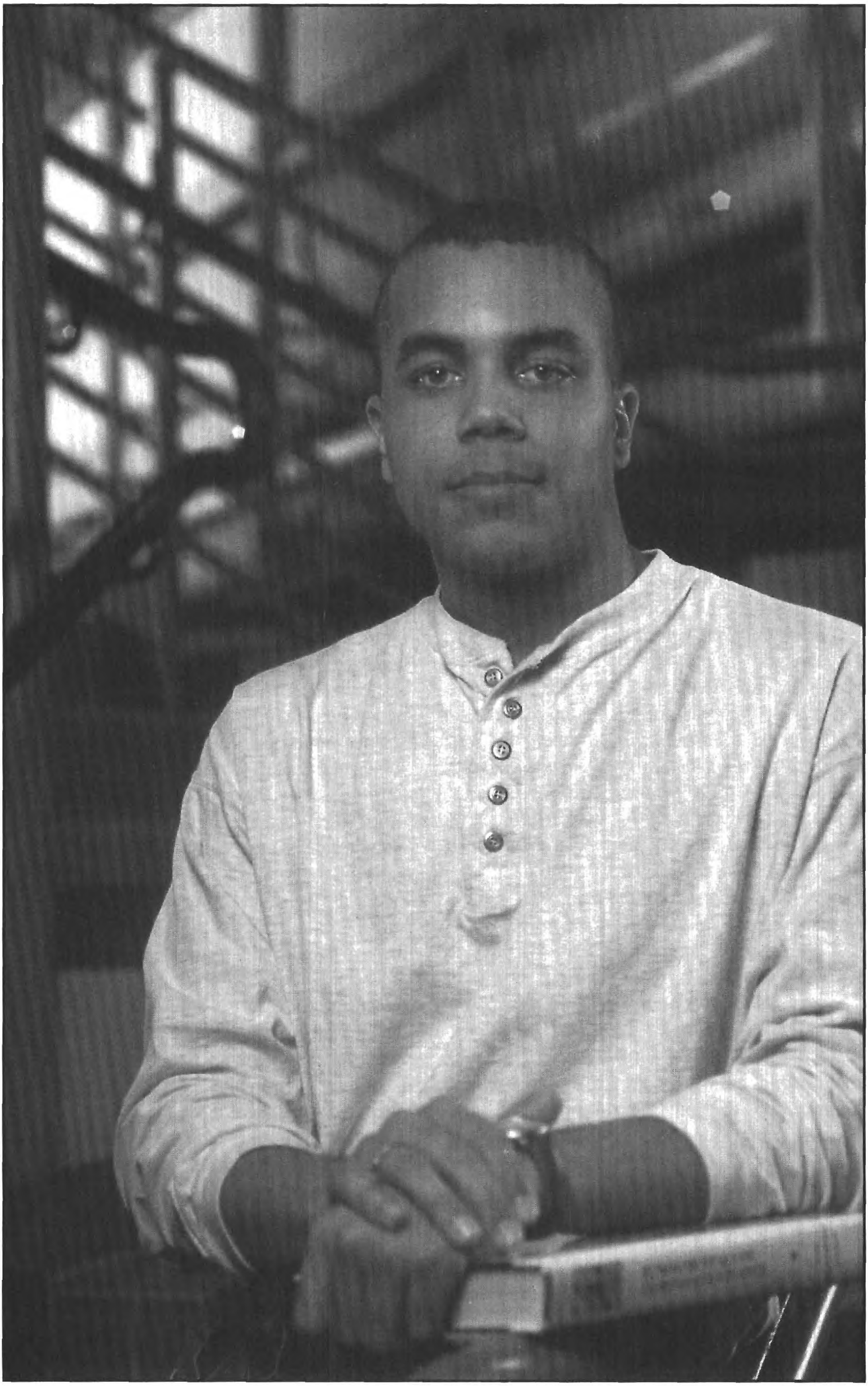
CS 8901,-2,-3. Special Problems
Credit hours to be arranged
Small-group or individual investigation of advanced topics in computing. Guided study and research.

CS 8997. Teaching Assistantship
Credit hours to be arranged
For graduate students holding graduate teaching assistantships.

CS 8998. Research Assistantship
Credit hours to be arranged
For graduate students holding graduate research assistantships.

CS 8999. Doctoral Thesis Preparation
Credit hours to be arranged

CS 9000. Doctoral Thesis
Credit hours to be arranged



DuPree College of Management

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Established in 1913 as School of Commerce
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Interim Dean–Lloyd Byars; *Director of MSM Program*–Ann Johnston Scott; *Director of MSM Career Services*–Mary McRee; *Director of Undergraduate Programs and Associate Professor*–Deborah Turner; *Associate Director of Undergraduate Programs*–Yvette McDonald; *Director of Development*–Lee Suddath; *Fuller E. Callaway Chair*–Eugene E. Comiskey; *Regents' Professor*–Naresh K. Malhotra; *Director of the DuPree Center for Entrepreneurship and New Venture Development and Professor*–Terry C. Blum; *Director of International Center for Continuous Quality Improvement and Associate Professor*–Soumen Ghosh; *Director of the Center for International Business Education and Research and Professor*– John R. McIntyre; *Hal and John Smith Chair of Entrepreneurship and Small Business Management and Professor*–Jeffrey G. Covin; *Thomas R. Williams Chair in Finance and Professor*–Cheol Eun; *Invesco Chairholder in Finance and Professor*–Eric C. Chang; *Professors*–Philip Adler, Fred C. Allvine, Yih-Long Chang, Cheryl Gaimon, Robert Hawkins, David Herold, Arthur Kraft, Ferd Levy, Charles Mulford, Charles Parsons, Leonard Parsons, Richard Teach; *Associate Professors*– Bryan Church, Andrew J. Cooper, Richard Daniels, Anindya Datta, Donald Fedor, Narayanan Jayaraman, Jackie Kleiner, Patricia McDougall, Dennis Nagao, Sridhar Narasimhan, Arnold Schneider, Christina Shalley, Vinod Singhal, Francis Ulgado; *Assistant Professors*–Goutam Callagalla, Jin-Wan Cho, Michael Heeley, Kenneth Kahn, Ajay Khorana, Saby Mitra, Nagesh Murthy, Edward Nelling, Sue Rhee, Frederick Riggins, Milind Shrikhande, Krishnamurthy Suysekar.

General Information

The College of Management provides education of the highest quality to prepare students for careers as managers or for additional study at the graduate level. The growing complexity of modern organizations has resulted in an increased need for college graduates with formal preparation in management.

The College of Management offers an undergraduate program leading to the Bachelor of Science in Management. This program allows sufficient flexibility for the student to develop and follow his or her own educational goals. The program is accredited by the American Assembly of Collegiate Schools of Business.

Problem solving takes place in a complex technical, social, and political environment. Students can sharpen the basic tools of management by understanding the natural, life, and social sciences, exploring the environment of the business enterprise, and gaining knowledge of the internal activities of the enterprise itself. Thus, every student is required to take course work in laboratory science, humanities, and the social sciences. Students become familiar with the fundamental activities of management by taking courses such as accounting, economics, information technology, marketing, operations management, finance, and strategic management. The use of computers is an integral part of the College program.

Undergraduate Program

Transfer Credit Policy for Undergraduate Students

Students may transfer courses taken at another accredited institution if the courses are passed with a grade of *C* or better and are deemed by the College of Management to be equivalent to a Georgia Tech course. Such courses will be transferred for the same number of credits as the corresponding College of Management courses provided they are equal to three or more semester hours of credit.

For institutions within the University System of Georgia, the total number of credit hours transferred for courses within the core curriculum* will match the number of credit hours granted by the originating institution. Hours of credit in excess of the corresponding Georgia Tech courses may be transferred only as free electives. For courses taken outside the core curriculum, the rules in the previous paragraph will apply.

Junior- or senior-level courses with three or more semester hours of credit that have no corresponding College of Management course may transfer as electives in management if they are approved by the College of Management. Because of the difference in the intellectual level of various courses, freshman- or sophomore-level courses taken at other institutions may only be transferred for equivalent freshman- or sophomore-level courses offered at Georgia Tech. (Exception: University System of Georgia schools may transfer the equivalent of MGT 2106, Business Law and Ethics, if taught at the freshman or sophomore level. Business Law and Ethics has been designated as a core course.)

* Core curriculum for this purpose may be defined as 2000-level management and management science courses plus Business Law and Ethics.

Pass/Fail Courses

Up to nine credit hours in the named category of Free Electives may be taken on a pass/fail basis if no nonresident credit has been awarded. (See the table of allowed pass/fail credit hours on p. 30 for more information.)

Prerequisites

Management majors should complete all required 2000-level Management courses prior to registering for 3000- and 4000-level Management courses.

Bachelor of Science

Students with a broad interest in all management activities and operating problems should profit from the management degree program. The program builds upon knowledge of the functional, environmental, behavioral, and legal aspects of business and provides analytic and conceptual tools for analyzing complicated problems. It prepares the student for managerial responsibilities and decision making. The large number of elective hours allows the student to tailor a program to his or her individual educational objectives. Students may take a concentration of electives in areas such as finance, accounting, marketing, operations management, international management, and information systems.

Bachelor of Science in Management Curriculum (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501 or MATH 1712		4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
LAB SCIENCE	(BIOL, CHEM, PHYS, EAS)	4
TOTAL SEMESTER HOURS		14

First Year - Spring Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502 or MATH 1711		4
HPS 1040/1061 WELLNESS		2
LAB SCIENCE (BIOL, CHEM, PHYS, EAS)		4
CS 1301	COMPUTER SCIENCE I	3
TOTAL SEMESTER HOURS		16

Second Year - Fall Semester

Course Number/Name		*Hours*
ECON 2105	MACROECONOMICS	3
MGT 2250	MANAGEMENT STATISTICS	3
ACCT 2101 or ACCT 2111	ACCOUNTING I	3
HUMANITIES ELECTIVE		3
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		15

Second Year - Spring Semester

Course Number/Name		*Hours*
ECON 2106	MICROECONOMICS	3
MGT 2106	LEGAL ASPECTS - BUSINESS	3
ACCT 2102 or ACCT 2112	ACCOUNTING II	3
MGT 2251	INTRO. TO MGT. SCIENCE	3
MGT 2200	INFORMATION TECHNOLOGY	3
TOTAL SEMESTER HOURS		15

Third Year - Fall Semester

Course Number/Name		*Hours*
MGT 3062	FINANCIAL MANAGEMENT	3
MGT 3101	ORGANIZATIONAL BEHAVIOR or	
MGT 3150	PRINCIPLES OF MANAGEMENT	3
MGT 3102	HUMAN RESOURCES	3
HUMANITIES ELECTIVE		3
FREE ELECTIVE		3
TOTAL SEMESTER HOURS		15

Third Year - Spring Semester

Course Number/Name		*Hours*
MGT 3300	MARKETING MANAGEMENT I	3
MGT 3501	OPERATIONS MANAGEMENT	3
MGT 3660	INTERNATIONAL BUSINESS	3
MANAGEMENT ELECTIVE		3
NON-MANAGEMENT ELECTIVE		3
TOTAL SEMESTER HOURS		15

Fourth Year - Fall Semester

Course Number/Name	*Hours*
MANAGEMENT ELECTIVE	3
MANAGEMENT ELECTIVE	3
MANAGEMENT ELECTIVE	3
MANAGEMENT ELECTIVE	3
NON-MANAGEMENT ELECTIVE	3
TOTAL SEMESTER HOURS	15

Fourth Year - Spring Semester

Course Number/Name		*Hours*
MGT 4195	STRATEGIC MANAGEMENT	3
MANAGEMENT ELECTIVE		3
FREE ELECTIVES		11
TOTAL SEMESTER HOURS		17

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HRS)

Electives

Health and Performance Science Electives

Students are required to complete 2 hours of Health and Performance Science courses selected from HPS 1040 or HPS 1061.

Humanities Electives

Students are required to complete 6 hours of humanities selected from CORE AREA C Humanities/Fine Arts listed on p. 33 of this catalog. Humanities electives transferred from other institutions may be used to fulfill this 6-hour requirement.

Note: Any courses completed that were listed in prior catalogs as satisfying the Humanities requirement and were completed while that catalog was in effect may also be used to satisfy this requirement.

Social Sciences Elective

Students must complete 12 hours of social science electives. Students are required to complete the U.S. and Georgia History and Constitution requirement with 3 semester hours selected from HIST 2111, 2112; POL 1101; PUBP 3000; INTA 1200.

Students must complete 6 hours of Economics: ECON 2105 and ECON 2106.

Three additional semester hours of social science are to be completed. This course may be selected from CORE AREA E Social Sciences listed on pages 33-34 of this catalog.

Mathematics Elective

Students must complete 8 hours of mathematics electives to be selected from MATH 1501 or MATH 1712 and MATH 1502 or MATH 1711

School Specific Electives/College of Management Electives

Students must complete 18 hours of College of Management electives. Management or management science courses, not otherwise required, will satisfy this requirement. These electives may not be taken on a pass/fail basis.

Non-College of Management Electives

Students must complete 6 semester hours of Non-College of Management electives. These courses may be selected from any academic area outside the College of Management. HPS and PE courses are not allowed. The courses must be taken on a letter-grade basis.

Free Electives

Students must complete 14 hours of free electives. These electives may be selected from any academic area including the College of Management. These courses may not be required otherwise by this curriculum or used elsewhere in this curriculum. Unlimited hours of HPS courses and 3 hours of PE courses are allowed. A maximum of 9 pass/fail hours are allowed. The student must consult the table on page 30 of this catalog and/or obtain advising in the DCOM Office of Undergraduate Programs, DCOM Suite 103, regarding allowable pass/fail hours.

Certificate Programs

In addition to its degree programs, the College of Management offers students in good standing an opportunity to broaden their areas of expertise or acquire skills or information beyond their major degree requirements. Students who satisfactorily complete this special program will receive a certificate of recognition.

Certificate programs available for undergraduate students are the following:

- Accounting
- Finance
- Information Technology Management
- International Management
- Marketing
- Operations Management

Graduate Programs

The DuPree College of Management offers graduate programs leading to the Master of Science in Management (M.S.M.), the undesignated Master of Science, and the Doctor of Philosophy.

The Master of Science in Management Program (M.S.M.)

The M.S.M. program, which is accredited by the American Assembly of Collegiate Schools of Business, provides a professional management education for students with baccalaureate degrees in any discipline. Calculus is the only prerequisite. For students who want to review and sharpen their quantitative and computer knowledge, review courses are offered in mathematics and computer skills prior to the fall semester.

The Master of Science in Management is an innovative and rigorous two-year, full-time business program with a technical and quantitative instructional focus. Highly qualified candidates from all academic backgrounds enter the program, which is small, intentionally designed to foster teamwork and a closely knit class.

In the summer term between the first and second academic years, M.S.M. students work as interns in companies such as The Coca-Cola Company, UPS, and BellSouth. The internship program provides an opportunity to apply managerial skills in an actual business environment.

The M.S.M. program is full time and comprises 20 courses (normally 60 hours), 10 of which are required. These 10 courses form a common core of knowledge required of all M.S.M. students. The remaining 10 elective courses provide flexibility for students to build competence in one or more concentration areas. This freedom permits each student to fashion a curriculum directed toward individual educational and career goals.

Concentration areas may include accounting, finance, human resources, information technology, international business, marketing, operations management, and strategic management. Students may also elect to take courses in the entrepreneurship, international business, or management of technology interdisciplinary certificate programs, or up to three courses outside the DuPree College.

Entry is in the fall semester only, and enrollment is strictly full time. The typical course load is five courses per semester. As no graduate courses are offered during the summer, students are encouraged to participate in the College's internship program during the summer between the first and second years of the program.

Some M.S.M. core classes are restricted to only M.S.M. students. Students in other graduate programs at Georgia Tech should check with the College of Management's Graduate Office regarding eligibility to register for these courses.

Applicants to the M.S.M. program should note that supplementary application materials are required by the College of Management in addition to those requested by Georgia Tech's Office of Graduate Studies. Incomplete applications will not be reviewed. M.S.M. application forms, as well as program description materials, may be obtained by writing to the DuPree College of Management, Room 212, Georgia Institute of Technology, Atlanta, Georgia 30332-0520, or by calling (404) 894-8722.

The undesignated Master of Science degree program serves students whose educational and career goals may not be best served by the M.S.M. program. Under these circumstances, the student can pursue a specially tailored master's-level curriculum that satisfies the American Assembly of Collegiate Schools of Business (AACSB) common body of knowledge requirements and provides a coherent concentration of elective courses chosen in consultation with an academic advisor. This specialized degree program is designed primarily for students who are admitted to Georgia Tech on approved foreign education programs. Admission to this program must be approved by the Master's Committee of the DuPree College of Management prior to enrollment.

The Ph.D. Program in Management

The Ph.D. program in management is designed to produce graduates who can make scholarly contributions to their chosen fields. Most graduates undertake careers as teachers, scholars, and researchers in academic environments. The doctoral degree also can lead to careers in industry and government.

The doctoral program in the DuPree College of Management is intended for full-time students who will complete their entire doctoral program prior to leaving the campus. Full-time residence in or near Atlanta is expected. The doctoral program is strongly research oriented and emphasizes early and effective involvement in research, with students experiencing considerable personal attention and close interaction with faculty. The Ph.D. program complements and reflects the technological emphasis of the Institute and places considerable weight on learning outside the classroom. The tutorial model is the basic educational model employed throughout the program.

All doctoral students take comprehensive examinations, which include both a general and a special examination. The student becomes a candidate for the degree after successful completion of both exams and the approval of the prospectus of his or her dissertation. On completion of the dissertation, the student must take a final oral examination as prescribed in the general regulations of the graduate division.

Applicants to the doctoral program in management should note that supplementary application materials are required by the College of Management in addition to those required by Georgia Tech's Office of Graduate Studies. Incomplete applications will not be reviewed. Ph.D. application forms, as well as program description materials, may be obtained by writing to the DuPree College of Management, Room 212, Georgia Institute of Technology, Atlanta, Georgia 30332-0520, or by calling (404) 894-8722.

The Master of Science in Management of Technology

The curriculum provides technically knowledgeable individuals with the breadth in business and management issues needed to more effectively manage in a technology-intensive environment. The program builds on the participants' technical knowledge and provides application-oriented management tools. Since participants continue to work, they have the maximum opportunity to immediately apply their new knowledge in their jobs. MS-MOT students typically have a technical undergraduate education and a minimum of five years of work experience in a technology-intensive environment.

Participants are expected to have the cooperation of their employers, who will provide them with release time for classes and financial support for program costs.

The curriculum utilizes a systems/processes framework in which business enterprises are viewed as consisting of multiple, interdependent processes. The focus on organizational work processes leads to a broader, more integrative, cross-functional perspective than the more traditional orientation of the M.S.M. In addition to the specified sequence of courses, the program features:

Group learning and team building: Teams are an important learning element of the program. Teams allow individuals from different industries, companies, and functional areas to pool their knowledge and expertise as they work on individual and team assignments.

Communication skills development: The expertise and insight of management graduates is virtually useless if they are unable to write and speak articulately about their ideas. The curriculum includes modules focusing on composition and presentation skills taught by faculty trained in technical and creative writing and in public speaking. Course requirements will provide students with many opportunities to practice their communication skills through oral presentations and a variety of writing assignments.

Computer skills enhancement: The Georgia Tech environment reinforces the importance of familiarity with computer-based techniques of analysis and communication. Basic computer applications including word processing, spreadsheets, database and statistics packages, as well as the use of electronic mail and networks, are integrated throughout the curriculum.

Degree Requirements and Schedule

The MS-MOT degree requires 54 quarter (36 semester) credit hours of study consisting of a fixed sequence of courses over an 18-month period. The curriculum sequence begins with a weeklong residency on campus followed by classes on alternating weekends (all day Friday and Saturday) during the term. A second weeklong campus residency begins the second half of the program. The program concludes with a two-week international residency. A new class enters and begins the sequence each June.

Student performance in most classes is graded on the traditional *A, B, C, D, F* scale. To graduate, students must have no more than three grades of *C* or lower and must have a cumulative grade point average of 3.0.

Management of Technology Certificate

The MOT Certificate Program is designed for graduate students enrolled in any discipline. However, students entering the program must have a "technical background." Either bachelor or graduate-level study in engineering, physical sciences, or computer science will generally satisfy this requirement. In unusual cases, this requirement may be satisfied by industrial experience of a sufficiently technical nature. In the design of the program, major emphasis has been placed on the interdisciplinary nature of managing technology in any institutional setting. For more information, contact the MOT Program Office at (404) 894-1462.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

ACCOUNTING

ACCT 2101. Accounting I: Financial Accounting
3-0-3.
An introduction to the measurement and financial reporting of organizations and the interpretation of the resulting financial statements.

ACCT 2102. Accounting II: Managerial Accounting
3-0-3. Prerequisite(s): ACCT 2101 or ACCT 2111
The course deals with determining the costs of products and services and using cost information for planning and decision making.

ACCT 2111. Honors Accounting I: Financial Accounting
3-0-3.
An introduction to the measurement and financial reporting of organizations and the interpretation of the resulting financial statements.

ACCT 2112. Honors Accounting II: Managerial Accounting
3-0-3. Prerequisite(s): ACCT 2101 or ACCT 2111
The course deals with determining the costs of products and services and using information for planning and decision making.

INTERNATIONAL EXECUTIVE MASTER'S IN BUSINESS ADMINISTRATION

IMBA 6000. Strategic Decision Making and Compromise Game
1-0-1.
A multifirm, competitive management simulation. The objective is to sharpen intra-firm communications skills using the internet as the communications channel and the art of compromise.

IMBA 6010. Cross-Cultural Communications for Management
2-0-2.
Participants learn tools and information to improve communications skills with new approaches and increased understanding while taking into account the effects of cross-cultural differences on communications.

IMBA 6020. Analytical Tools for International Business
3-0-3.
Widely used organization and simulation techniques that are useful for analyzing decision situations. Emphasis is placed on the application and use of theoretical knowledge.

IMBA 6030. Organizational Behavior and Theory
3-0-3.
Students learn the basic concepts and principles of organizational behavior and utilize such to analyze and solve organizational decision-making problems.

IMBA 6040. Economic Anlaysis of Decisions in a Global Economy
3-0-3.
Participants are provided with a nontraditional approach using an analytical method with a global perspective to the concepts and role of economics in the world environment.

IMBA 6050. Financial and Managerial Accounting
3-0-3.
Course covers financial reporting and analysis issues facing firms, and managerial accounting information necessary for planning, controlling, and decision making within such firms.

IMBA 6060. Information Systems for Management
3-0-3.
Students focus on managing the information technology function and make extensive use of cases to illustrate key IT decisions that need to be made by organizations.

IMBA 6070. Managerial Finance in World Markets
4-0-4.
A two-part course providing an understanding of finance concepts and how they are used. The course further integrates international and ethical considerations wherever applicable.

IMBA 6080. Operations and Logistics Management
3-0-3.
Concepts and issues critical to the globalization of manufacturing and services operations.

IMBA 6090. Marketing and Consumer Behavior
3-0-3.
Students are provided with an understanding of marketing and consumer behavior concepts and tools with an international environment approach.

IMBA 6100. New Product Design and Marketing Research
1-0-1.
The interdisciplinary nature of product development and management, and market research. Students cover product issues that emerge during the product life cycle.

IMBA 6110. Risk Management and Technology Transfer
2-0-2.
A course based upon a combination of cases, historical data, and theoretical interpretation on the analysis and allocation of risk in international investment and technology transfer

IMBA 6120. Human Resource Management
3-0-3.
Participants learn how to manage people to gain global competitive advantage, and are exposed to international cases.

IMBA 6130. Strategy, Policy, and Planning
3-0-3.
Teaches the design and implementation of corporate business, and functional strategies that will achieve sustainable competitive advantage in the international arena.

IMBA 6140. Comparative Management Systems
2-0-2.
This course utilizes case studies of companies in various industries and in national cultures to highlight organizational and cultural differences between major economies in the global environment.

IMBA 6150. Entrepreneurship and Entrepreneurial Firms
1-0-1.
Participants explore the increasing importance of small and medium-sized businesses and new ventures in international business.

IMBA 6160. National and International Regulation of Business
2-0-2.
Deals with learning how to control the legal aspects of international decisions.

IMBA 6170. Quality, Sustainable Technology, Competitiveness
1-0-1.
Students learn the philosophy and techniques of strategic quality management while focusing on assessment and group decisions centered on sustaining technology and competitiveness.

IMBA 6180. Leadership Skills and Processes
1-0-1.
Focuses on identifying and developing the attributes of successful leadership.

IMBA 6200. Strategic Business Simulation
2-0-2.
A unifying course providing a simulated application of the material taught in the core courses of the program.

IMBA 6210. Analysis of Emerging Technology
2-0-2.
A case-based course dealing with the role and impact of digital technology in large and small organizations, with special emphasis on multinational companies.

IMBA 6220. Applied Entrepreneurship Seminar
1-0-1.
A case course building an information bank of theory and practice on start-up enterprises. Several entrepreneurs will co-teach the course with a faculty leader.

IMBA 6230. International Business Negotiations
1-0-1.
A role-play course involving the complex international negotiation simulation dealing with an international business enterprise and its relationship with one or more governments.

MANAGEMENT

MGT 2106. Legal, Social, Ethical Aspects of Business
3-0-3.
Development and function of the law, court organization, procedure, and substantive law in contracts, business organizations, and agencies. Also exposes social responsibility and ethics in business.

MGT 2200. Management Applications of Information Technology
3-0-3. Prerequisite(s): CS 1301
An introduction to management computing with a focus on the support of information technology to management functions. Students are introduced to database and spreadsheet applications.

MGT 2250. Management Statistics
3-0-3. Prerequisite(s): MATH 1712 or MATH 1501
Introduction to basic statistics for management students.

MGT 2251. Introduction to Management Science
3-0-3. Prerequisite(s): MGT 2250
This course focuses on the problem-solving and decision-making processes that use quantitative management science concepts and techniques.

MGT 3000. Accounting for Decision Making
3-0-3.
A foundation course in measuring and reporting the financial performance and status of the firm as well as basic concepts in cost and managerial accounting.

MGT 3062. Financial Management
3-0-3. Prerequisite(s): ACCT 2101
An introduction to finance. Topics include: time value of money, capital budgeting, risk and return, captial structure, dividend policy, and working capital management.

MGT 3075. Security Valuation
3-0-3. Prerequisite(s): MGT 3062
The valuation of securities using fundamental and technical analysis. Topics include: DCF valuation, price multiples, free cash flow, and the construction of quantitative trading models.

MGT 3076. Investments
3-0-3. Prerequisite(s): MGT 3062
Introduction to the securities markets and a study of the theory and practice of security analysis and portfolio management as applied to stocks and bonds.

MGT 3078. Finance and Investments
3-0-3.
An introduction to finance and to the securities markets. Topics include: time value of money, risk and return, capital budgeting, security analysis, and portfolio management of stocks, bonds, and derivatives.

MGT 3079. Management of Financial Institutions
3-0-3. Prerequisite(s): MGT 3062
Introduction to the various risks faced by financial institutions and a detailed analysis of the tools used to manage these risks.

MGT 3084. Derivative Securities
3-0-3. Prerequisite(s): MGT 3062
An introduction to options, futures, and swaps is provided. Concepts of arbitrage, index trading, and portfolio insurance are discussed.

MGT 3101. Organizational Behavior
3-0-3.
Introduction to how the behavior of individuals, groups, and organizations affects organizational effectiveness.

MGT 3102. Managing Human Resources Within a Regulatory Environment
3-0-3.
Analysis of various frameworks for understanding the social regulatory environments of human resources management and how they influence management decision making.

MGT 3150. Principles of Management
3-0-3.
Course explores functions of management; planning, organizing, staffing, leading, and controlling. Lectures, case studies, and business exercises are used to reinforce principles that are taught.

MGT 3300. Marketing Management I
3-0-3. Prerequisite(s): ECON 2106
The course presents and develops the primary marketing variables that are used in designing an overall marketing program. A systems approach is taken with the variables managed to optimize overall results.

MGT 3310. Marketing Research: Qualitative Aspects
3-0-3. Prerequisite(s): MGT 3300
This course covers the fundamentals of the qualitative aspects of marketing research. The course has an applied orientation with application to contemporary issues in marketing.

MGT 3325. Product Planning
3-0-3. Prerequisite(s): MGT 2250
An overview of issues inherent in product development and product management. These include product strategy, idea generation, market development, product positioning, test marketing, launch, and brand management.

MGT 3501. Operations Management
3-0-3. Prerequisite(s): MGT 2251
This course focuses on the issues and techniques relevant to the management of the operations function within an organization, emphasizing its strategic significance.

MGT 3610. Managing Resources of the Technological Firm
3-0-3. Prerequisite(s): MATH 1712 or MATH 1501
This course explores the competitive advantage manufacturing and service firms derive from the effective management of their technology, work force, materials, and information resources.

MGT 3660. International Business
3-0-3. Prerequisite(s): MGT 3150
Examines the position of the U.S. in world markets, various types of international business transactions, and the relationship of business to global economic, political-legal, and cultural forces.

MGT 3661. Advanced Concepts in International Business
3-0-3. Prerequisite(s): MGT 4155
Covers significant aspects of international business with a particular focus on the challenges associated with transnational corporations.

MGT 4010. Business Taxation
3-0-3. Prerequisite(s): ACCT 2101 or ACCT 2111
Comprehensive survey of federal taxation of business. A focus on tax planning and decision making will extend to the study of the tax code and regulations.

MGT 4015. Advanced Managerial Accounting
3-0-3. Prerequisite(s): ACCT 2102 or ACCT 2112
The course will examine current issues in managerial accounting using case studies and emphasizing service industries.

MGT 4026. Financial Reporting and Analysis I
3-0-3. Prerequisite(s): ACCT 2101 or ACCT 2111
Intermediate-level treatment of revenue recognition, inventories, contracts, interest capitalization, property and equipment, intangibles, long-term liabilities, and shareholders' equity. Significant emphasis on financial analysis.

MGT 4027. Financial Reporting and Analysis II
3-0-3. Prerequisite(s): ACCT 2101 or ACCT 2111
Advanced topics including tax reporting, leases, pensions, foreign currency transactions, hedging, statement translation, and business combinations and consolidations. Significant emphasis on financial analysis.

MGT 4028. Financial Reporting and Analysis for Technology Firms
3-0-3. Prerequisite(s): ACCT 2101 or ACCT 2111
An indepth look at reporting standards for and the financial characteristics of technology firms, with an emphasis on the financial analysis of such firms.

MGT 4030. International Accounting
3-0-3. Prerequisite(s): ACCT 2101 or ACCT 2111
An overview of accounting issues arising from the increased internationalization of business. Topics include comparative financial reporting among countries and accounting treatments of international transactions.

MGT 4041. Auditing and Financial Control Systems
3-0-3. Prerequisite(s): ACCT 2101 or ACCT 2111
This course covers professional issues surrounding auditing and financial control systems. Topics include management fraud, legal liability, audit evidence, etc.

MGT 4045. Seminar in Advanced Accounting Topics
3-0-3. Prerequisite(s): ACCT 2101 or ACCT 2111
An intensive treatment of a selection of contemporary accounting topics. Topical coverage may span subject matter ranging across the fields of auditing, systems, and managerial and tax accounting.

MGT 4051. Decision Support and Expert Systems
3-0-3. Prerequisite(s): MGT 2200
This course discusses the basic features of decision support systems and expert systems. It covers development tools and business applications.

MGT 4052. Systems Analysis and Design
3-0-3. Prerequisite(s): MGT 2200
An introductory course on the development life cycle of business information systems. It covers analysis and design tools and methodology.

MGT 4053. Business Data Communications
3-0-3. Prerequisite(s): MGT 2200
Introductory data communication concepts. Data communication applications in organizations. Overview of data communication products and services available from a technology consumer perspective.

MGT 4055. International Issues in Information Technology Management
3-0-3. Prerequisite(s): MGT 2200
An overview of international issues in the Information Technology Management (ITM) area. Topics include: offshore software development, transborder data flow restrictions, global connectivity issues.

MGT 4056. Electronic Commerce
3-0-3. Prerequisite(s): MGT 2200
This course examines the business and technical issues related to electronic commerce applications, such as the Internet, WWW, EDI, and electronic linkages between trading partners.

MGT 4057. Business Process Analysis and Design
3-0-3. Prerequisite(s): MGT 2200
Business processes are the mechanisms by which work is organized and performed. This course covers why, when, and how processes should be analyzed and designed.

MGT 4058. Database Management Systems
3-0-3. Prerequisite(s): MGT 2200
An introductory course on databases providing hands-on experience with a DBMS. Topics include data modeling, relational database design, and SQL.

MGT 4070. International Finance
3-0-3. Prerequisite(s): MGT 3062
Financial management in an international setting. Topics include: foreign exchange markets, exchange risk management, international portfolio investment, and foreign direct investment.

MGT 4071. Multinational Financial Management
3-0-3. Prerequisite(s): MGT 3062 and MGT 4070
This course emphasizes decision making for the multimedia firm amidst exchange rate fluctuations, differing tax structures across countries, and political risk via lectures, case discussion and analysis, and project-based learning.

MGT 4155. Fundamentals of Global Management
3-0-3. Prerequisite(s): MGT 3150
Covers the broad aspects of international business, position of the U.S. in world markets, various types of international business transactions, and the relationship of business to economics, politics, culture, and government interaction.

MGT 4190. Strategic Quality Management and Competitiveness
3-0-3. Prerequisite(s): MGT 3150
This course examines the philosophy and techniques of strategic quality management (e.g. cycle-time management, learning organizations, quality control) as means to promote individual productivity and improve organizational competitiveness.

MGT 4191. The Entrepreneurship Forum
3-0-3.
This course provides an understanding of the entrepreneurial process, explores the role of the entrepreneur, and identifies the critical issues in starting ventures and working in entrepreneurial organizations.

MGT 4195. Strategic Management
3-0-3. Prerequisite(s): MGT 3062 and MGT 3300 and MGT 3501 and (MGT 3100 or MGT 3150)
The use of cases, guest lecturers, and gaming to integrate analysis and measurement tools, functional areas, and public policy issues. The objective is to develop skills in broad areas of rational decision making in the administrative context of uncertainty.

MGT 4303. Sales Management
3-0-3. Prerequisite(s): MGT 3300
Students will obtain an understanding of the management of the sales function. The importance of the marketing-sales interface will be stressed.

MGT 4305. Business to Business Marketing
3-0-3. Prerequisite(s): MGT 3300
This course studies the marketing of products and services for resale, for use in producing other goods and services, and for the operations of an enterprise.

MGT 4307. Strategic Marketing
3-0-3. Prerequisite(s): MGT 3300
Students will obtain an understanding of strategic marketing development and alternatives. Analysis and implementation through functional marketing strategies will be stressed.

MGT 4331. Consumer Behavior
3-0-3. Prerequisite(s): MGT 3300
An applied course that provides a basic understanding of the behavioral science concepts to explain the behavior of consumers in the marketplace.

MGT 4335. International Marketing
3-0-3. Prerequisite(s): MGT 3300
Students will obtain an understanding of marketing across national borders and cultures. The differences and similarities throughout the marketing functions are explored.

MGT 4352. Operations Planning and Control
3-0-3. Prerequisite(s): MGT 3501
This course focuses on the variety of control systems used to manage the replenishment process within organizations.

MGT 4353. Operations Strategy
3-0-3. Prerequisite(s): MGT 3501
This course provides knowledge about developing, implementing, and evaluating operations strategy. It stresses the relationships between the operations and other functions of the organization.

MGT 4360. Global Operations and Logistics
3-0-3. Prerequisite(s): MGT 3501
This course is designed to present issues critical to the globalization of operations manufacturing services, and addresses the impact of the global scope of operations in attaining a sustained competitive advantage in the global marketplace.

MGT 4365. Quality Control and Improvement
3-0-3. Prerequisite(s): MGT 3501
This course focuses on statistical process control, robust design, and acceptance sampling of productive systems.

MGT 4366. Service Operations Management
3-0-3. Prerequisite(s): MGT 3501
This course analyzes operational performance for the service and for service support functions of manufacturers. Industries include information services, health care, parking, transportation, distribution, and retail.

MGT 4660. Entrepreneurship for Engineers
3-0-3. Prerequisite(s): ACCT 2101 and MGT 3062 and MGT 3300
Provides engineering students with an understanding of the process of establishing a technology-based venture. Students learn how to evaluate market opportunities, conduct feasibility studies, create venture teams, and write business plans.

MGT 4661. Database Management
3-0-3. Prerequisite(s): MGT 2200
An introductory course on databases providing hands-on experience with a DBMS. Topics include data modeling, relational database design, and SQL.

MGT 4803. Special Topics
3-0-3.
Permits a group of students and a professor to pursue areas of management not extensively treated in any other course.

MGT 4811,-2,-3,-4,-5. Special Topics in Management
Credit and class hours equal last digit of course number
Permits a group of students and a professor to pursue areas of management not extensively treated in other courses.

MGT 4901,-2,-3. Individual Research in Management
Credit hours to be arranged
Designed to permit independent study with a faculty member.

MGT 4990. Internship Program
Credit hours to be arranged.
Broadens the scope of the College by offering students a community-based learning experience that stresses the completion of a specific task.

MGT 6000. Financial and Managerial Accounting I
3-0-3.
A foundation course in measuring and reporting the financial performance and status of the firm as well as basic concepts in cost and managerial accounting.

MGT 6010. Business Taxation
3-0-3. Prerequisite(s): MGT 6000
Comprehensive survey of federal taxation of business. A focus on tax planning and decision making will extend the study of the tax code regulations.

MGT 6015. Managerial Accounting II
3-0-3. Prerequisite(s): MGT 6000
The course covers cost estimation, standard costs, variable costing, relevant costs, transfer pricing, performance evaluation, cost of quality, and activity-based costing for service.

MGT 6020. Financial Reporting and Analysis I
3-0-3. Prerequisite(s): MGT 6000
Intermediate-level treatment of revenue recognition, inventories, contacts, interest capitalization, property and equipment, intangibles, long-term liabilities, and shareholders' equity. Significant emphasis on financial analysis.

MGT 6022. Financial Reporting and Analysis II
3-0-3. Prerequisite(s): MGT 6000
Advanced topics including tax reporting, leases, and pensions.

MGT 6028. Financial Reporting and Analysis of Technology Firms
3-0-3. Prerequisite(s): MGT 6000
An indepth look at reporting standards for, and the financial characteristics of technology firms, with an emphasis on the financial analysis of such firms.

MGT 6030. International Accounting
3-0-3. Prerequisite(s): MGT 6000
An overview of accounting issues arising from the increased internationalization of business. Topics include comparative financial reporting among countries and accounting treatments of international transactions.

MGT 6042. Auditing and Financial Control Systems
3-0-3. Prerequisite(s): MGT 6000
This course covers professional issues surrounding auditing and financial control systems. Topics include management fraud, legal liability, audit evidence, etc.

MGT 6045. Seminar in Advanced Accounting Topics
3-0-3. Prerequisite(s): MGT 6000
An intensive treatment of a selection of contemporary accounting topics. Topical coverage may span subject matter ranging across the fields of auditing, systems, and managerial and tax accounting.

MGT 6050. Management Information Systems
3-0-3.
This course provides an introduction to the use of information systems in modern organizations. Various issues relating to the management of information technology are discussed.

MGT 6051. Database Development and Applications
3-0-3. Prerequisite(s): MGT 6050
The role of databases in the modern enterprise. Design and development of database systems. Applications in accounting, marketing, operations, and human resource systems.

MGT 6052. Systems Analysis and Design
3-0-3. Prerequisite(s): MGT 6050
An introduction to the development life cycle of business information systems. It covers analysis and design tools and methodology.

MGT 6053. Business Data Communications
3-0-3. Prerequisite(s): MGT 6050
Introductory data communication concepts. Data communication applications in organizations. Overview of data communications products and sevices available from a technology consumer perspective.

MGT 6054. International Issues in Information Technology Management
3-0-3. Prerequisite(s): MGT 6050
An overview of international issues in the information technology management area. Topics include: offshore software development, transborder data flow restrictions, global connectivity.

MGT 6055. Decision Support and Expert Systems
3-0-3. Prerequisite(s): MGT 6050
This course discusses the basic features of decision support systems and expert systems. It covers development tools and business applications.

MGT 6056. Electronic Commerce
3-0-3. Prerequisite(s): MGT 6050
This course examines the business and technical issues related to electronic commerce applications, such as the Internet, WWW, EDI, and electronic linkages between trading partners.

MGT 6057. Business Process Analysis and Design
3-0-3. Prerequisite(s): MGT 6050
Business processes are the mechanisms by which work is organized and performed. This course covers why, when, and how processes should be analyzed and designed.

MGT 6060. Financial Management
3-0-3. Prerequisite(s): MGT 6000
An introduction to finance. Topics include time value of money, capital budgeting, risk and return, capital structure dividend policy, and working capital management.

MGT 6066. Corporate Restructurings
3-0-3. Prerequisite(s): MGT 6060
This course seeks to give students an understanding of issues in corporate restructuring. Topics include valuation, mergers, acquisitions, spin-offs, financial distress, corporate governance, and high-leveraged transactions.

MGT 6070. International Finance
3-0-3. Prerequisite(s): MGT 6060
Financial management in an international setting. Topics include: foreign exchange markets, exchange risk management, international portfolio investment, and foreign direct investments.

MGT 6071. Multinational Financial Management
3-0-3. Prerequisite(s): MGT 6070
This course emphasizes decision making for the multinational firm amidst exchange rate fluctuations, differing tax structures across countries, and political risk via case discussion and analysis.

MGT 6080. Investments
3-0-3. Prerequisite(s): MGT 6060
Introduction to securities markets and study of theory and practice of security analysis and portfolio management concepts as applied to equities and fixed-income securities.

MGT 6081. Derivative Securities
2-0-2. Prerequisite(s): MGT 6060
An introduction to options, futures, and swaps is provided. Concepts of arbitrage, index trading, and portfolio insurance are discussed.

MGT 6085. Entrepreneurial Finance
3-0-3. Prerequisite(s): MGT 6060
This course teaches future managers and entrepreneurs the financial perspectives in value creation.

MGT 6090. Management of Financial Institutions
3-0-3. Prerequisite(s): MGT 6060
Introduction to the various risks faced by financial institutions and a detailed analysis of the tools used to manage these risks.

MGT 6100. Leadership and Organizational Behavior
3-0-3.
The focus of this course is on behavioral issues in the management of individual, team, and organization performance.

MGT 6101. Managing Human Resources
3-0-3.
An examination of the tools and procedures used by organizations to attract, select, and retain employees within the context of the legal and regulatory environment.

MGT 6106. Teamwork in Organizations
3-0-3. Prerequisite(s): MGT 6100
The focus of the course is on understanding the use, management, and performance of teams and teamwork in organizational settings.

MGT 6107. Leadership and Organizational Change
3-0-3. Prerequisite(s): MGT 6100
An examination of theories and practices for designing and implementing major organizational change and the role played by leadership, power, and influence in the change process.

MGT 6109. Management Aspects of Advanced Manufacturing Technology
3-0-3.
Examines organizational and human resources management implications of advanced manufacturing technology. Focuses on key management choices that impact the successful implementation of new technologies.

MGT 6110. Negotiation and Conflict Resolution
3-0-3.
This course covers the theory and process of negotiation and conflict resolution as it is practiced in different settings.

MGT 6111. Innovation and Entrepreneurial Behavior
3-0-3.
An examination of organizational policies, practices, and cultures that foster innovative and entrepreneurial behavior, even in the context of large organizations.

MGT 6112. Managing Organizational Learning, Quality, and Business Process Improvement
3-0-3.
An examination of theories and methods used by organizations to achieve higher levels of product and service quality through improvements in learning and work processes.

MGT 6165. Venture Creation
3-0-3.
Focuses on creating a new business venture. Requires completing a business plan, which describes and analyzes a proposed venture.

MGT 6176. Managing the Growing Firm
3-0-3.
This course examines the challenges associated with the successful management of growth. Models and theories of firm growth will be reviewed.

MGT 6184. International Trade/Export-Import Management
3-0-3.
An examination of U.S. trade policy, laws, and regulations as well as the mechanics of export and import management.

MGT 6185. International Business Environments
3-0-3.
This course explores international environmental factors impacting firms' globalizing operations. Factors covered range from economic, political, and legal to socio-cultural and technology forces.

MGT 6195. Strategic Management
3-0-3.
This course examines the environmental and organizational factors that affect the performance of firms as well as the role of top managers in the organizational governance process.

MGT 6197. Global Strategic Management
3-0-3.
This course provides a forum for the in-depth examination of the managerial and organizational demands associated with effectively competing in global industries.

MGT 6198. Corporate Entrepreneurship for Global Competitiveness
3-0-3.
This course examines how strategic pioneering actions and innovation are used by organizations to renew themselves, their markets, and their industries.

MGT 6300. Marketing Management I
3-0-3.
This course presents and develops the primary marketing variables that are used in designing an overall marketing program. A system approach is taken with the variables managed to optimize overall results.

MGT 6302. Consumer Behavior
3-0-3.
This course exposes students to behavior science concepts and approaches in understanding and predicting the behavior of consumers.

MGT 6303. Sales Management
3-0-3. Prerequisite(s): MGT 6300
Students will obtain an understanding of the management of the sales function. The importance of the marketing-sales interface will be stressed.

MGT 6305. Strategic Marketing
3-0-3. Prerequisite(s): MGT 6300
Students will obtain an understanding of integration of marketing planning into the strategic planning process. Focuses on concepts that facilitate the development of a strategic plan.

MGT 6306. Business to Business Marketing
3-0-3. Prerequisite(s): MGT 6300
This course studies the marketing of products or services for resale, for use in producing other goods, and service operations of an enterprise.

MGT 6310. Marketing Research: Qualitative Aspects
3-0-3.
A state-of-the-art course focusing on the qualitative aspects of marketing research. The course has a strong managerial orientation emphasizing applications in several areas including international marketing research.

MGT 6315. Marketing Analysis
3-0-3. Prerequisite(s): MGT 6600
This course seeks to impart an understanding of the various applied multivariate techniques available for analyzing and interpreting marketing data.

MGT 6318. Marketing Technology
3-0-3. Prerequisite(s): MGT 6600
Focuses on using computer decision models in making marketing decisions.

MGT 6320. Building Implementable Market Response Models
3-0-3. Prerequisite(s): MGT 6600
Knowing that a company can take actions that affect its own sales market response models can be used to aid in planning and forecasting.

MGT 6325. Product Planning
3-0-3. Prerequisite(s): MGT 6300
Examines issues inherent in product development and product management. These include product strategy, idea generation, market development, product positioning, test marketing, and launched brand management.

MGT 6326. Collaborative Product Development
3-0-3. Prerequisite(s): MGT 6300
Examines issues inherent in product development and product management. These include product strategy, idea generation, market development, product positioning, test marketing, and launched brand management.

MGT 6335. International Marketing
3-0-3. Prerequisite(s): MGT 6300
Students will obtain an understanding of marketing across national borders and cultures. The differences and similarities throughout marketing functions are explored.

MGT 6350. Operations Management
3-0-3. Prerequisite(s): MGT 6600
This course focuses on the issues and techniques relevant to the management of the organization within and recognizing its strategic significance.

MGT 6351. Operations Planning and Control
3-0-3. Prerequisite(s): MGT 6350
This course focuses on the variety of control systems used to manage the replenishment process within organizations.

MGT 6353. Operations Strategy
3-0-3. Prerequisite(s): MGT 6350
This course provides knowledge about developing, implementing, and evaluating operations strategy. It stresses the relationships between operations and other functions of the organization.

MGT 6357. Service Operations Management
3-0-3. Prerequisite(s): MGT 6350
This course analyzes operational performance for the service sector and service support functions of manufacturers. Industries include information services, health care, banking, transportation, distribution, and retail.

MGT 6358. Quality Control and Improvement
3-0-3. Prerequisite(s): MGT 6350
Course focuses on statistical process control, robust design, and acceptance sampling of productive systems.

MGT 6360. Global Operations and Logistics
3-0-3. Prerequisite(s): MGT 6350
This course presents issues critical to the globalization of operations and addresses the impact of the operations in attaining a sustained competitive advantage in the global marketplace.

MGT 6600. Analytical Tools for Decision Support
3-0-3.
Exposes students to the most commonly used statistical and optimization-based analytical tools for decision support. The knowledge of these tools enables the decision maker to make informed decisions based on the data available.

MGT 6772. Managing Resources of the Technological Firm
3-0-3.
This course explores the competitive advantage manufacturing and service firms derive from effective management of their technology, work force, materials, and information resources. Crosslisted with ISYE 6772.

MGT 6773. Strategic Management of Technology-Based Ventures
3-0-3.
This course provides a forum for the indepth examination of issues involving the strategic management of high-tech corporate start-ups and small technology-based businesses. Crosslisted with ISYE 6773.

MGT 6774. Management of Technology Project
3-0-3.
This course organizes students into multidisciplinary teams devoted to solving a real problem for a technology-based firm. Crosslisted with ISYE 6774.

MGT 6775. Management of Technology Seminar
1-0-1.
This course introduces the frontiers of key technologies, provides a forum for visiting speakers from the corporate world, and supplements topics from other MOT courses. Crosslisted with ISYE 6775.

MGT 6777. Analysis of Emerging Technologies
3-0-3.
The course develops skills in the use of selected methods for technology monitoring, forecasting, and assessment. Also examines current status and prospects in selected emerging technology domains. Crosslisted with ISYE and PUBP 6777.

MGT 6780. Knowledge Management
3-0-3. Prerequisite(s): MGT 6050
The purpose of this course is to enable students to think conceptually about the modern organization as a knowledge-based, information-processing organization. Crosslisted with PUBP 6780.

MGT 6788. Legal Issues in Biomedical Engineering
3-0-3.
Study and analysis of U.S. government laws applicable to the development and clinical use of biomedical engineering technology. Crosslisted with ECE, CHE, ME, and BMED 6788.

MGT 6789. Technology Transfer in Biomedical Engineering
3-0-3.
Team discussion and case studies in biomedical engineering technology transfer, including licensing, financial capital, safety and efficacy studies, clinical trials, and strategic planning. Crosslisted with BMED, ECE, CHE, and ME 6789.

MGT 6811. Integrative Management Analysis
3-0-3.
Integrates the functional areas of management, economics with the external environment of businesses. Provides understanding of the current surroundings and pressures under which managers operate.

MGT 6813. Economic Analysis for Managers
3-0-3.
Economic reasoning and principles useful in understanding and solving managerial and public policy questions. Practice in analyzing major domestic and international economic events is included.

MGT 6814. Law, Management, and Economics
3-0-3. Prerequisite(s): MGT 6100
The interrelationships among law, economics, and managerial decision making. Focuses on the legal and economic environments that impinge on profit-seeking enterprises.

MGT 6820. Unstructured Managerial Problems
3-0-3. Prerequisite(s): ECON 6000 and MGT 6813
Solving unstructured managerial problems. Emphasis is placed on understanding the behavioral and economic theories that impinge on the environment of the firm and affect managerial choice.

MGT 6901. Consulting
3-0-3.
Students work in teams for client firms in a consulting capacity. The client firms are preselected, but the problem definition is derived from client-team negotiations.

MGT 7000. Master's Thesis
Credit hours to be arranged

MGT 7060. Theory of Finance
3-0-3.
An introduction to theoretical financial economics. This course focuses on individuals' consumption and investment decisions under uncertainty and their implications on the valuation of securities.

MGT 7061. Empirical Finance
3-0-3.
A survey of selected current empirical research topics in finance and related econometric issues.

MGT 7062. Corporate Restructuring
3-0-3.
An analysis of empirical research in corporate finance with a focus on issues related to corporate restructuring.

MGT 7063. International Finance
3-0-3.
An introduction to the foundations of modern international finance. Topics include: international portfolio diversification, design of country funds, tests of asset pricing, and international corporate finance.

MGT 7101. Human Resources Management
3-0-3.
An analysis of advanced practice, research, and theory in human resource management. Topics will vary by instructor and student interest.

MGT 7102. Organization Behavior Research Methods
3-0-3.
Overview and analysis of research methodologies used in conducting scientific research of organizational behavior.

MGT 7105. Individual Behavior in Organizations
3-0-3.
The course is designed to investigate organizational behavior research topics at the individual level of analysis.

MGT 7106. Group Dynamics
3-0-3.
Provides a fundamental understanding of group processes in organizations by analyzing and critiquing classic and contemporary theories and research on groups.

MGT 7107. Organizational Theory
3-0-3.
Review of contemporary organizational theories and empirical studies of them to provide a framework to understand organizational structures, environment, and goals.

MGT 7305. Marketing Management and Strategy
3-0-3.
The course provides a survey of research and theory in the marketing management and strategy literature.

MGT 7320. Marketing Science
3-0-3.
This doctoral course addresses the literature on state-of-the-art research on quantitative approaches to marketing problems.

MGT 7350. Operations Strategy I
3-0-3.
The seminar will discuss research papers dealing with strategic issues in operations management.

MGT 7351. Operations Strategy II
3-0-3.
The seminar is a continuation of MGT 7350 and will deal with more advanced strategic issues in operations management.

MGT 7352. Operations Planning and Control I
3-0-3.
This seminar will discuss research papers dealing with tactical and operational (planning and control) issues in operations management.

MGT 7353. Operations Planning and Control II
3-0-3.
This seminar is a continuation of MGT 7352 and will discuss advanced papers dealing with tactical and operational (planning and control) issues in operations management.

MGT 7354. Research Methods in Operations Management
3-0-3.
This seminar will discuss papers dealing with research methods in operations management.

MGT 8803. Special Topics in Management
3-0-3.
Topics of current interest in the field of management.

MGT 8850. Research Topics in Finance
3-0-3.
Coverage of special research topics of current interest in finance.

MGT 8851. Research Topics in Organizational Behavior
3-0-3.
Coverage of research topics of current interest in organizational behavior.

MGT 8853. Research Topics in Marketing
3-0-3.
Coverage of special research topics of current interest in marketing.

MGT 8855. Research Topics in Operations Management
3-0-3.
Coverage of special research topics of current interest in operations management.

MGT 8903. Special Problems in Management
Credit hours to be arranged.
Provides project work experience in the field of management.

MGT 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding graduate teaching assistantships.

MGT 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding graduate research assistantships.

MGT 9000. Doctoral Thesis
Credit hours to be arranged.

MANAGEMENT OF TECHNOLOGY

MOT 6101. Frameworks for Managing Technology
1-0-1.
The sociotechnical aspects of organizations are examined, and participants' technological and people skills (communications, teamwork, conflict resolution) are enhanced.

MOT 6102. Economic Analysis for Managers
2-0-2.
Studies the economic concepts that describe and explain the environment within which firms operate.

MOT 6103. Financial and Managerial Accounting
2-0-2.
Covers the basic concepts that underlie the use of accounting information. Includes balance sheet, income statement, alternative costing systems.

MOT 6104. Financial Management in an Environment of Technological Change
2-0-2.
Course focuses on financial concepts and how they are used to maximize the value of the firm and choose among alternative courses of action.

MOT 6105. Analytical Tools for Decision Support
2-0-2.
This course focuses on statistics and mathematical modeling of use to decision makers in technology environments with significant uncertainty.

MOT 6106. Processes of Technological Innovation
2-0-2.
This course addresses the processes involved in technological innovation, focusing on models, sources, flows, and the protection of innovation.

MOT 6107. Technology Strategies in Information Systems
2-0-2.
This course examines information systems and their impact on manufacturing and service operations.

MOT 6108. Concepts and Practice of Project Management and Quality Management
1-0-1.
This course introduces basic issues and techniques relevant to project and quality management.

MOT 6109. Mananging People in a Technical Environment
2-0-2.
This course focuses on the management and leadership of people and human resource systems in modern organizations.

MOT 6110. Technology and Transformational Work Processes
2-0-2.
This course focuses on how work processes within organizations can be designed and managed to optimize output effectiveness.

MOT 6111. Organizational Transformation Methods
2-0-2.
This course introduces methods to adapt, evolve, or create change in the way organizations structure themselves to increase effectiveness in responding to competitive demands.

MOT 6112. Marketing in a Technical Environment
2-0-2.
This course focuses on the marketing function, its relationship to other functions within the firm, and its strategic significance to high-tech organizations.

MOT 6113. International Issues in the Management of Technology
2-0-2.
The impact of globalization on the management of technology is explored through a two-week study tour in Europe.

MOT 6114. Seminar in the Management of Technology
2-0-2.
This seminar features senior executives from organizations that develop or use technology discussing current practices, policies, and issues.

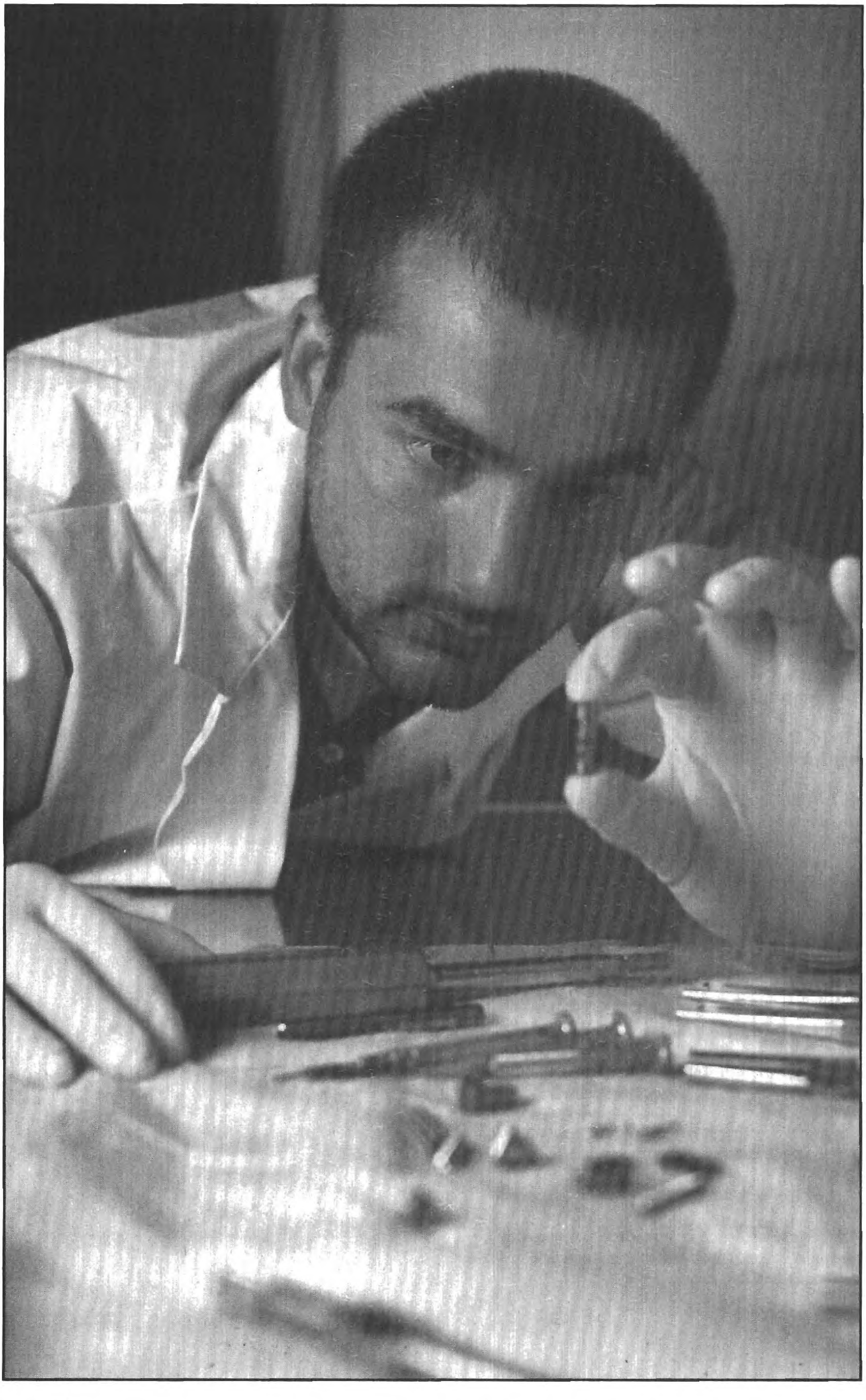
MOT 6115. Forecasting and Analysis of Emerging Technologies
2-0-2.
This course examines key emerging technologies, their development patterns, and the associated impact on industries, industrial competitiveness, and society.

MOT 6116. Strategy in Management of Technology
2-0-2.
This course examines and discusses how technology-based firms develop and implement business, functional, and technology strategies.

MOT 6120. Management of Technology Project I
2-0-2.
Participants develop and present a proposal for a technology-based research project of interest to them and of importance to their organization.

MOT 6121. Management of Technology Project II
2-0-2.
Participants execute their MOT project research proposals, including data collection and preliminary analysis.

MOT 6122. Management of Technology Project III
2-0-2.
Participants complete their MOT project research, submit a written report, and present their results to their organization.



College of Engineering

WWW.COE.GATECH.EDU/

College established in 1948,
First engineering program in 1885
Location: 225 North Avenue
Atlanta, GA 30332-0360
Telephone: (404) 894-2600/2624
Fax: (404) 894-3350
Website: www.coe.gatech.edu
E-mail: coe@coe.gatech.edu

Dean–Jean-Lou Chameau; *Associate Dean*–J. Narl Davidson; *Associate Dean*–Jack R. Lohmann; *Assistant Deans*–Lytia R. Howard, Jane G. Weyant; *Director of Continuing Engineering Education*–R. Dale Atkins; *Director of Development*–Marta H. Garcia; *Director of Special Projects*–Robert G. Haley; *Director of Finance and Personnel*–Elizabeth Ann Minor.

General Information

The College of Engineering comprises nine degree-granting schools of instruction and research. The schools offer programs of study and research leading to bachelor's, master's, and doctoral degrees. Some of the schools also offer programs in one or more subdisciplines or subspecialties. These degree offerings are summarized in an accompanying table.

The programs in engineering are designed to provide a fundamental understanding of the engineering sciences, which are based on mathematics and the natural sciences, of the basic concepts of the humanities and social sciences, and an understanding of the manner in which these elements are interwoven in engineering practice. Each curriculum provides enough flexibility through elective course opportunities to permit a certain amount of program individualism while meeting basic requirements.

College of Engineering Degree Programs

Program	Degree Level		
Aerospace Engineering	B	M	Ph.D.
Bioengineering		M	Ph.D.
Chemical Engineering	B	M	Ph.D.
Civil Engineering	B	M	Ph.D.
Computer Engineering	B		
Electrical Engineering	B		
Electrical and Computer Engineering		M	Ph.D.
Engineering Science and Mechanics		M	Ph.D.
Environmental Engineering		M	Ph.D.
Health Physics		M	
Health Systems		M	
Industrial Engineering	B	M	Ph.D.
Materials Science and Engineering	B	M	Ph.D.
Mechanical Engineering	B	M	Ph.D.
Metallurgy		M	Ph.D.
Nuclear and Radiological Engineering	B	M	Ph.D.
Operations Research		M	Ph.D.
Polymers		M	Ph.D.
Statistics		M	
Polymer & Textile Chemistry	B	M	Ph.D.
Textile & Fiber Engineering	B	M	Ph.D.
Textile Enterprise Management	B	M	

Transfer Programs in the College of Engineering

To encourage and accommodate students who desire to study engineering, but who for various reasons may prefer to attend another college before coming to Georgia Tech, the College of Engineering offers the opportunity to transfer to Georgia Tech through the **Regents' Engineering Transfer Program (RETP)** or the **Dual Degree Program.**

Regents' Engineering Transfer Program

The RETP is a cooperative program between Georgia Tech and nine colleges in the University System of Georgia:

- Albany State University
- Armstrong Atlantic State University
- Columbus State University
- Georgia Southern University
- Macon State College
- Middle Georgia College
- North Georgia College & State University
- Valdosta State University
- State University of West Georgia

For the first two years, students in this program attend one of the participating institutions where they take all of the mathematics and science and many of the engineering courses required in the first two years of the Georgia Tech engineering curricula. Upon successful completion of the RETP requirements at the RETP institution, students are admitted to Georgia Tech to work toward completion of a bachelor of science in engineering degree.

By enrolling in RETP, students may attend a college close to home that can decrease the cost of their education and ease the adjustment to college life. At the same time, RETP students enjoy many of the following advantages of Tech students: they have equal access to engineering majors at Tech, they can participate in the co-op program, and they are invited to the Tech campus once a year for campus tours, information sessions, and meetings with advisors in their engineering major.

Dual Degree Program

Under the Dual Degree Program, students attend the participating Dual Degree school for three years and then come to Georgia Tech for approximately two years. Students participating in the Dual Degree Program may seek a degree from any undergraduate degree-granting program in the College of Engineering. Upon completion of the program, the student receives a bachelor's degree from the first school and a bachelor's degree in one of the engineering disciplines at Georgia Tech.

Participating in the Dual Degree Program are many of the schools in the University System of Georgia, Morehouse College, Spelman College, Clark Atlanta University, Morris Brown College, and other traditionally black colleges and predominantly women's colleges in the Southeast.

For additional information on either of these programs, contact the College of Engineering at Georgia Tech or the RETP or Dual Degree coordinator at a participating RETP or Dual Degree institution.

Georgia Tech Regional Engineering Program (GTREP)

The College of Engineering is working with the Presidents' Offices at Armstrong Atlantic State University, Georgia Southern University, and Savannah State University to develop a new regional engineering program that will provide the opportunity for students to obtain engineering degrees in a number of disciplines. The new programs will share some common characteristics with the existing Regents' Engineering Transfer program (RETP), but will enable students to earn degrees without physically relocating to the Georgia Tech campus.

Additional details can be obtained by contacting the College of Engineering at Georgia Tech at (404) 894-3350.

Graduate Programs

Bioengineering

In response to the increased need for engineers and medical scientists with advanced training in bioengineering, Georgia Tech now offers master's and doctoral degrees in bioengineering. The purpose of bioengineering as a research discipline is to develop new and better physical and mathematical concepts and techniques that may be applied to problems in medicine and biology, to the development of new medical devices, and to the organization and delivery of cost-effective health care. Interdisciplinary in scope, the program offers advanced courses in engineering specialties, life sciences, and bioengineering combined with training in biomedical research.

The interdisciplinary graduate programs in bioengineering are offered by the College of Engineering in conjunction with the Institute for Bioengineering and Biosciences (in the Office of Interdisciplinary Programs), the College of Sciences, and the College of Computing. The student will have a home school within the College of Engineering, which, upon completion of the student's requirements, will recommend the degree. This interdisciplinary approach has been approved by the faculty in the schools of Aerospace Engineering, Biomedical Engineering, Chemical Engineering, Civil and Environmental Engineering (Engineering Science and Mechanics Program), Electrical and Computer Engineering, Materials Science and Engineering, Mechanical Engineering, and Textile and Fiber Engineering, and by the deans of the colleges of Engineering, Sciences, and Computing.

The program is for engineering graduates who wish to pursue a graduate degree in bioengineering rather than in a traditional field of engineering, or who have done bioengineering research in other disciplines. In addition, those interested students with nonengineering backgrounds (with degrees in such fields as computer science, physics, chemistry, biology, or mathematics) who meet the admission requirements will be admitted to the program. Applications from physicians with undergraduate degrees in engineering or the physical sciences will also be considered. All applications will be processed through the Institute for Bioengineering and Biosciences.

Polymers

In response to the need for scientists and engineers with advanced training in polymers, Georgia Tech offers M.S. and Ph.D. programs in polymers. These degrees are currently offered through three schools–Chemical Engineering, Materials Science and Engineering, and Textile and Fiber Engineering. The core requirements for the polymer degrees are the same in each school. This core is designed to provide a balanced treatment of chemistry, physics, and engineering, with additional emphasis on advanced aspects of either chemistry or engineering of polymeric materials. In addition, the wide range of elective courses and research projects available permits students to develop an indepth knowledge of a particular area of polymer science or engineering. This combination of breadth and depth of study is vital to the successful performance of polymer science and engineering graduates.

Graduate research in polymers is also conducted by students majoring in the disciplines of chemical, electrical, materials, mechanical, and textile and fiber engineering, as well as chemistry and physics. The broad range of multidisciplinary research conducted by Georgia Tech faculty spans fundamental aspects of polymer synthesis, polymer reaction engineering, rheology, phase transitions, solid-state structure, and chemical, electronic, mechanical, and transport properties. Application areas include biomedical materials, cellular foams, coatings, fibers, films, membranes, microelectronic materials, and structural composites.

Administration

The student's program is administered by the school of residence. The research and educational activities of the different schools in polymers are coordinated through the Office of the Director of Polymer Education and Research Center (PERC).

Admissions Information

All correspondence regarding admission for graduate study in polymers should be addressed to the director of PERC at Georgia Tech. The application should indicate the student's desired school of residence. These applications will be reviewed by a PERC committee and forwarded, with the appropriate recommendation, by the director of PERC to the school of residence desired by the applicant. Admission to the graduate degree programs requires the approval of PERC and the school of residence. The final decisions regarding admission and financial aid are made by the school of residence. Since the requirements for the polymer program are the same in each school, applicants should consider the research projects available in each school. If admission or financial aid is denied by the intended school of residence to an applicant who receives positive recommendation from PERC, consideration will be given by the other schools participating in the Graduate Polymer Degree Programs.

Multidisciplinary Certificate Programs in Engineering

In addition to its degree programs, the College of Engineering provides opportunities for specialized study in engineering through its multidisciplinary certificate program offerings. Any student in good academic standing who is pursuing a degree in one of the participating schools of the College of Engineering or a participating school in any of the other colleges may select elective courses and the subjects of special problems to satisfy simultaneously both the requirements of his or her major degree program and those of a specialized multidisciplinary program. Upon graduation, the student receives both the degree in the major field of study and a certificate attesting to successful completion of the particular related multidisciplinary program.

The following table shows available program offerings and the degree levels of the programs.

Multidisciplinary Programs

Program	Degree Level		
Acoustical Engineering		M	Ph.D.
Composites Engineering	B	M	Ph.D.
Geohydrology		M	Ph.D.
Manufacturing		M	Ph.D.
Mechanical Properties of Solids			Ph.D.
Polymer Engineering	B	M	Ph.D.
Pulp and Paper Engineering	B		

General Requirements of Undergraduate Multidisciplinary Programs

The specific design of the multidisciplinary program of any participating undergraduate student, while individualized, must meet certain general requirements as well as requirements that are specific to that multidisciplinary area. The general (minimum) undergraduate multidisciplinary requirements are as follows:

(1) the program must relate the student's major area to the given multidisciplinary area;
(2) courses must be taken under more than one academic unit;
(3) at least 12 credit hours (not required by name and number in the student's major) must be taken in a coherent program;
(4) at least 9 credit hours must be at the 3000 level or higher;
(5) at least 3 credit hours must be outside the major field (cross-listed courses may be counted outside the student's major); and
(6) courses must be taken on a letter-grade basis, and a grade of *C* or better must be earned in each course counting toward a multidisciplinary certificate.

General Requirements of Graduate Multidisciplinary Programs

The specific design of the multidisciplinary program of any participating graduate student, while individualized, must meet certain general requirements as well as requirements that are specific to that multidisciplinary area. The general (minimum) graduate multidisciplinary requirements are the same as those listed previously for the undergraduate programs, with the following exceptions:

(1) at least 3 of the coherent multidisciplinary program courses as well as 9 credit hours must be at the 6000 level or higher;
(2) students at the doctoral level must, on an individual basis, meet additional requirements specified by the student's doctoral committee, consistent with a program beyond the master's level whose objective is to develop a doctoral-level multidisciplinary program.

Interested students may obtain detailed information on the various undergraduate-level and graduate-level multidisciplinary programs from the main office of the school in which they are enrolled.

Certificate Procedures

Petitions for multidisciplinary program certificates are processed as follows:

(1) During the semester in which the student expects to graduate, the student obtains a Petition for Multidisciplinary Certificate form from the academic advisor of his or her major school, or from the chairperson of the relevant multidisciplinary program. The student completes the form, then obtains the signature of the chair of his or her school, as well as the signature of the chairperson of the certificate program.
(2) When complete, the petition is forwarded to the Office of the Dean of Engineering.
(3) At the end of the semester, if the appropriate school director and the multidisciplinary chairperson have certified that the major program requirements and

special program requirements have been satisfactorily met, and the registrar has verified that all graduation requirements have been met, each certificate will be signed by the multidisciplinary chairperson and by the dean.

(4) Multidisciplinary certificates are sent to recipients after graduation. A copy of the petition and certificate are on file in the Office of the Dean of the College of Engineering.

School of Aerospace Engineering

Daniel Guggenheim School of Aeronautics, Established in 1930
Location: Montgomery Knight Building
Telephone: (404) 894-3000
Web address: www.ae.gatech.edu

Chair–Robert G. Loewy; *Associate Chair and Professor*–Jechiel I. Jagoda; *David S. Lewis Chair and Regents' Professor*–Ben T. Zinn; *Regents' Professor*–Lakshmi N. Sankar; *Regents' Professors Emeriti*–Robin B. Gray, Edward W. Price; *Professors*–K.K. Ahuja (joint, GTRI), Erian A. Armanios, Olivier A. Bauchau, Anthony J. Calise, James I. Craig, Wassim M. Haddad, Sathyanarayana V. Hanagud, Dewey H. Hodges, Manohar P. Kamat, George A. Kardomateas, Narayanan M. Komerath, David J. McGill (joint, CEE), Suresh Menon, J.V.R. Prasad, Daniel P. Schrage, Ramesh R. Talreja; *Professors Emeriti*–Robert L. Carlson, Donnell W. Dutton, Wilfred F. Horton, James E. Hubbartt, Howard M. McMahon, G. Alvin Pierce, James C. Wu; *Associate Professors*–Oliver G. McGee, Panagiotis Tsiotras, P.K. Yeung; *Assistant Professors*–Dimitri Marvis, John R. Olds, Amy R. Pritchett (joint, ISyE), Stephen M. Ruffin, Jerry M. Seitzman, Marilyn J. Smith; *Lecturer*–Michael W.M. Jenkins; *Adjunct Professor*–David A. Peters; *Senior Research Engineers*–Brady R. Daniel, Yedidia Neumeier, Robert K. Sigman; *Research Engineers II*–Ivan Y. Burdun, Daniel A. DeLaurentis, Mark A. Hale, Ralph L. Latham, Lawrence M. Matta, Jimmy C. Tai; *Research Engineers I*–Jeong Hur, David E. Scarborough; *Research Associate*–Harald W. Meyer.

General Information

The School of Aerospace Engineering prepares students at the bachelor's, master's, and doctoral levels for a career in vehicle engineering, with primary emphasis on flight vehicles. The School is housed in six buildings having a floor space of approximately 70,000 square feet, most of which is devoted to instructional and research laboratories. Additional information can be found on the School of Aerospace Engineering website at: www.ae.gatech.edu

Undergraduate Program

The first two years focus on course work in the areas of chemistry, mathematics, physics, humanities, social sciences, and general engineering sciences. The third and fourth years emphasize aerospace disciplines and vehicle systems integration. The undergraduate curriculum is designed to provide each student with a general background for either industry or graduate school at the end of four years. The program stresses the theoretical, experimental, and design aspects of aerospace engineering. Courses do not have to be taken during the semester indicated in the curriculum, but all prerequisites must be satisfied for each course. Advisement before registration is required. A certain degree of specialization is available to undergraduate students through the proper choice of electives, depending on the student's abilities and career objectives. Students should consult with academic advisors for the availability of courses and recommended course sequences.

Bachelor of Science in Aerospace Engineering (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
MATH 1501	CALCULUS I	4
ENGL 1101	ENGLISH COMPOSITION I	3
CHEM 1211	GENERAL CHEMISTRY	4
CS 1301	COMPUTER SCIENCE I	3
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS		16

First Year - Spring Semester

Course Number/Name		Hours
MATH 1502	CALCULUS II	4
ENGL 1102	ENGLISH COMPOSITION II	3
PHYS 2211	PHYSICS I	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000		
	or INTA 1200	3
AE 1350	INTRO. TO A.E.	2
TOTAL SEMESTER HOURS		16

Second Year - Fall Semester

Course Number/Name		Hours
MATH 2401	CALCULUS III	4
PHYS 2212	PHYSICS II	4
AE 2751	INTRO. TO MECHANICS	3
AE/ME/CEE 1770	ENGINEERING GRAPHICS	3
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		17

Second Year - Spring Semester

Course Number/Name		Hours
AE 2020	LOWSPEED AERODYNAMICS	3
AE 2220	DYNAMICS	3
LAB SCIENCE ELECTIVE (CHEM, BIOL, EAS)		4
ECON 2100	ECONOMICS & POLICY	3
MATH 2403	DIFFERENTIAL EQUATIONS	4
TOTAL SEMESTER HOURS		17

Third Year - Fall Semester

Course Number/Name		Hours
AE 3120	INTRO. STRUCTURAL ANALYSIS	3
AE 3520	VIBRATIONS & SYS. DYNAMICS	3
AE 3450	THERMO. & COMP. FLOW	3
AE 3051	EXPER. FLUID DYNAMICS	2
HUMANITIES ELECTIVE		3
MSE 2001	ENGR. MATERIALS	3
TOTAL SEMESTER HOURS		17

Third Year - Spring Semester

Course Number/Name		Hours
AE 3021	HIGH SPEED AERODYNAMICS	3
AE 3121	AE STRUCTURAL ANALYSIS	3
AE 3521	FLIGHT DYNAMICS	4
AE 3310	INTRO TO AE VEHICLE PERFORM.	3
AE 3145	STRUCTURES LAB	1
ECE 3710	CIRCUITS & ELECTRONICS	3
TOTAL SEMESTER HOURS		17

Fourth Year - Fall Semester

Course Number/Name		Hours
AE 4451	JET & ROCKET PROPULSION	3
AE 4520	FEEDBACK CONTROL SYSTEMS	3
AE 4350	DESIGN PROJECT I	3
ECE 3741	INSTRUMENTATION & ELECTR. LAB	1
SOCIAL SCIENCE ELECTIVE		3
FREE ELECTIVE		3
TOTAL SEMESTER HOURS		16

Fourth Year - Spring Semester

Course Number/Name		Hours
AE 4220	STRUC. DYNAMICS & AEROELAST.	3
AE 4351	AE DESIGN PROJECT II	3
SOCIAL SCIENCE ELECTIVE		3
FREE ELECTIVES		7
TOTAL SEMESTER HOURS		16

TOTAL PROGRAM HOURS = 130 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Requirements

A grade of *C* or better is required in each 1000- and 2000-level math and physics course; a course with a *D* or *F* grade must be repeated the next semester the student is in residence. A 2.0 overall average is required to schedule AE 2751 or AE 2020. No more than two *D* grades are permitted in courses listed by number in the sophomore, junior, and senior years (with the exception of ECON 2100). Courses in which a *D* was earned may be repeated at any time with the approval of an advisor. A student with two *Ds* and one *F* must repeat at least one of these courses before graduation.

Electives

Humanities/Social Sciences Electives

Twelve credit hours in humanities and twelve credit hours in social sciences are required for graduation. See pages 33-34 for a list of acceptable courses. Courses taken in humanities and social sciences must be scheduled on a letter-grade basis.

The courses selected to fulfill the humanities and social sciences requirements must provide both breadth and depth, and should not be a selection of unrelated introductory courses. The humanities and social sciences courses taken must include six credit hours at the 3000/4000 level. This requirement can be satisfied with two humanities courses, two social sciences courses, or one of each. Students should see their academic advisor for course sequences that satisfy the depth requirement.

To satisfy the state requirements regarding course work in the history and constitutions of the U.S. and Georgia, students must complete one of the following courses: HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200.

Free Electives

The 11 credit hours of free electives may be taken at any time during the course of study. If ROTC is elected, 4 credit hours of basic and six hours of advanced ROTC may be applied toward these electives. Physical education courses may not be applied toward the free electives. Health and Performance Sciences courses, except for HPS 1040 and 1061, may be applied toward the free electives. Up to 9 hours of free electives may be taken on a pass/fail basis. Transfer students are restricted to fewer pass/fail hours.

Graduate Programs

At the graduate level, the School offers master's and doctoral degrees. The master's degree may be earned by completing 33 semester hours of course work, which may include up to 3 hours of special problem research credit. Alternatively, the candidate may elect to complete 24 semester hours of course work along with an M.S. thesis, which includes a proposal and a defense. The Ph.D. degree is a research degree. It requires 50 semester hours of course work beyond the bachelor's degree. However, the main emphasis is on the research leading to the Ph.D. thesis. The candidate must pass a qualifying examination and present a thesis proposal and a thesis defense. GPAs of 2.7 and 3.25 are required to graduate with M.S. and Ph.D. degrees, respectively. All course work, including Special Problems, must be taken on a letter-grade basis.

The programs of study for both the master's and the doctoral degree are very flexible and can be tailored, in agreement with the student's advisor, to meet the candidate's professional goals. Further details governing the graduate program can be found in the *Aerospace Engineering Graduate Handbook*, available on the School of Aerospace Engineering website at: www.ae.gatech.edu/graduate/

Graduate students may specialize in the following areas: aerodynamics and fluid mechanics, aeroelasticity and structural dynamics, flight mechanics and control, propulsion and combustion, structural mechanics and materials behavior, and system design and optimization. Further information on these areas of specialization and research can be found at: www.ae.gatech.edu/research/

Multidisciplinary Programs

See table on page 122.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

AEROSPACE ENGINEERING

AE 1350. Introduction to Aerospace Engineering
2-0-2.
Introduction to the field of aerospace engineering, discussion of basic aerospace systems and disciplines, working vocabulary of the field. Demonstration through examples. Wind tunnel visit.

AE 1750. Introduction to Bioengineering
3-0-3.
An introduction to the field of bioengineering, including the application of engineering principles and methods to problems in biology and medicine, the integration of engineering with biology, and the emerging industrial opportunities. Crosslisted with CHE, ECE, ME, and MSE 1750.

AE 1770. Introduction to Engineering Graphics and Visualization
2-3-3. Co-requisite: MATH 1501.
Introduction to engineering graphics and visualization including sketching, line drawing, simple wire-frame, and solid modeling. Development and interpretation of drawings and specifications for product realization. Crosslisted with CEE 1770 and ME 1770.

AE 2020. Low-Speed Aerodynamics
3-0-3. Prerequisite(s): CS 1301 and MATH 2401 and PHYS 2212 and AE 1350.
Basic results, conservation laws, potential, airfoil and wing analysis. Boundary layers on plates and airfoils. Pressure gradients. Introduction to turbulence and vortex-dominated flows.

AE 2220. Dynamics
3-0-3. Prerequisite(s): AE 2751 or ME 2751; Co-requisite: MATH 2403.
Motion of particles and mass centers of bodies, kinematics and kinetics of rigid bodies in plane motion, work-energy and impulse-momentum methods, 3-D dynamics of rigid bodies.

AE 2751. Introduction to Mechanics
3-0-3. Prerequisite(s): PHYS 2211; Co-requisite: MATH 2401.
Forces and moments; equilibrium in two and three dimensions; multiforce members; friction; stress and strain; axially loaded members; torsion and bending of beams. Crosslisted with ME 2751

AE 2801,-2,-3. Special Topics
Credit hours equal the last digit in course number
Normally taken by sophomores. Course material devoted to special topics in aerospace engineering.

AE 2901,-2,-3. Special Problems
Credit hours to be arranged.
Research topic selected in consulation with advisor. A brief description, endorsed by the faculty advisor, must be approved by the School.

AE 3021. High-Speed Aerodynamics
3-0-3. Prerequisite(s): AE 2020 and AE 3450.
Compressibility effects on airfoil and wing aerodynamics; supersonic potential flow; method of characteristics; boundary layer effects on airfoil and wing performance.

AE 3051. Experimental Fluid Dynamics
1-3-2. Prerequisite(s): AE 2020; Co-requisite: AE 3450.
Experiments in fluid mechanics, aerodynamics, and propulsion with emphasis on data acquisition and analysis, e.g., measurement techniques, laboratory instrumentation, measurement errors/noise, and digital sampling.

AE 3120. Introduction to Structural Analysis
3-0-3. Prerequisite(s): (AE 2751 or ME 2751) and MATH 2403.
Euler-Bernoulli beam theory. Deflections due to bending. Bending of beams with unsymmetrical cross-section. Stability of beams and columns. Elements of two-dimensional elasticity.

AE 3121. Aerospace Structural Analysis
2-3-3. Prerequisite: AE 3120.
Principles of virtual displacements and virtual forces. Introduction to energy concepts. Introduction to finite elements. Bending, shear, and torsion of thin-walled structures.

AE 3145. Structures Laboratory
0-3-1. Co-requisite: AE 3120.
Introduction to mechanical measurements, instrumentation principles and practice, measurement of stress and strain, shear center, column stability, properties of composite structural materials, fracture toughness test.

AE 3310. Introduction to Aerospace Vehicle Performance
3-0-3. Prerequisite(s): AE 2020 and AE 2220.
Introduction to aerospace vehicle performance: VTOL, STOL, CTOL aircraft and spacecraft. Drag estimation, thrust required and available, basic point and path performance, special performance items, maneuvers.

AE 3450. Thermodynamics and Compressible Flow
3-0-3. Prerequisite(s): PHYS 2212.
First and second laws of thermodynamics. Thermodynamic properties and state equations. Isentropic flow. Flows with shocks and expansions. Flows with friction and heat transfer

AE 3520. Vibrations and System Dynamics
3-0-3. Prerequisite(s): AE 2220 and MATH 2403.
Simple, damped, and forced vibrations of one degree of freedom systems. Analogies with electrical and hydraulic aircraft control systems. Linear system analysis using Laplace transforms.

AE 3521. Aircraft and Spacecraft Flight Dynamics
4-0-4. Prerequisite(s): AE 2020 and AE 3520.
Three-dimensional rigid body dynamics, aircraft and spacecraft equations of motion, principles of static stability and control, dynamic stability of uncontrolled motion, gyroscopic instruments.

AE 3801,-2,-3. Special Topics
Credit hours equal the last digit in the course number.
Normally taken by juniors. Course material devoted to special topics in aerospace engineering.

AE 3901,-2,-3. Special Problems
Credit hours to be arranged.
Research topic selected in consultation with advisor. A brief description, endorsed by the faculty advisor, must be approved by the School.

AE 4040. Computational Fluid Dynamics
3-0-3. Prerequisite(s): AE 3021.
Discretization of PDEs, stability and accuracy considerations, iterative and time/space marching schemes, aerospace applications.

AE 4051. Flow Diagnostics
2-3-3. Prerequisite: AE 3051.
Overview of experimental techniques. Flow visualization; statistical methods. Laboratory operation, data acquisition, analysis, interpretation, reporting.

AE 4060. Aeroacoustics
3-0-3. Prerequisite: AE 3021.
Concepts and techniques, noise sources, data acquisition and reduction, aeroacoustic resonances, commonalities in the music of wind instruments and sources of aircraft noise, community impact.

AE 4070. Introduction to Propeller and Rotor Theory
3-0-3. Prerequisite: AE 3021.
A study of the theory and equations used for the performance of propellers and helicopter rotors.

AE 4080. Aerothermodynamics
3-0-3. Prerequisite: AE 3021.
Convective heat transfer and viscous drag in high-temperature and high-speed flowfields. Inviscid hypersonic theory, real gas effects, and wall thermal protection strategies.

AE 4120. Introduction to Aerospace Engineering Composite Structures
3-0-3. Prerequisite(s): AE 2751 or ME 2751.
Introduction to composite systems. Principles of manufacturing, structural mechanics of laminated composites. Aerospace design applications. Damage tolerance.

AE 4131. Introduction to Finite Element Methods
2-3-3. Prerequisite(s): AE 3121.
Finite element method and its application to linear structural problems. The basic formulations of various structural elements are discussed.

AE 4170. Structural Integrity and Durability
3-0-3. Prerequisite(s): AE 3120.
Multiaxial stress states, inelasticity in metals and polymers, yield criteria, metal fatigue, fracture, stress intensity factors, fracture toughness, fatigue crack growth, metal creep, and polymer viscoelasticity.

AE 4220. Structural Dynamics and Aeroelasticity
3-0-3. Prerequisite(s): AE 3121 and AE 3520.
Structural dynamics of one-dimensional systems. Analysis of static aeroelastic phenomena, unsteady aerodynamics, and flutter. Equations of motion for complete aeroelastic systems; solution techniques.

AE 4350. Aerospace Engineering Design Project I
2-3-3. Prerequisite(s): AE 3021 and AE 3310;
Co-requisites: AE 4451 and AE 4520.
Conceptual design methodology developed and applied incorporating center of gravity, inertias, structural layout, materials, propulsion integration, stability and control, vehicle sizing, performance, and acquisition costs.

AE 4351. Aerospace Engineering Design Project II
2-3-3. Prerequisite(s): AE 4350.
Design methodology further developed and applied. Teams formed to prepare competitive proposals in response to given mission requirements. Designs publicly presented and defended.

AE 4375. Fundamentals of Computer-aided Engineering and Design
3-0-3. Prerequisite(s): CS 1301 and MATH 2403.
Introduction to the principles of geometric modeling; 2-D systems; 3-D wireframe, surface and solid representations; mathematical representations of curves, surfaces, solids; application to aerospace design problems.

AE 4380. Astronautics
3-0-3. Prerequisite: AE 2220.
Introduction to the space environment, two-body orbital mechanics, rocket vehicle propulsion, performance, and staging. Interplanetary trajectories, atmospheric entry and heating, spacecraft communications.

AE 4451. Jet and Rocket Propulsion
3-0-3. Prerequisite(s): AE 3450.
Principles of aerospace propulsion systems. Thermodynamic cycles. Thermodynamics of combustion. Turbine engine and rocket performance characteristics. Cycle/component analysis of engines and turbomachinery.

AE 4461. Introduction to Combustion
3-0-3. Prerequisite(s): AE 3450.
Basics of combustion and combustion devices. Chemical thermodynamics, reaction rates, premixed/nonpremixed flames, ignition, stabilization, and pollutants. Applications in turbine, rocket, and internal combustion engines.

AE 4520. Feedback Control Systems
2-3-3. Prerequisite(s): AE 3521.
Dynamic response of linear systems. Classical methods of feedback control system design. Aerospace vehicle flight control system design, laboratory with emphasis on control system design.

AE 4521. Vehicle Guidance and Simulation
3-0-3. Prerequisite(s): AE 3521.
Simulation of aerospace systems. Simulation as an engineering tool. Mathematical modeling. Simulation of aircraft, spacecraft, missles, and guidance systems. Illustrative case studies.

AE 4757. Biofluid Mechanics
3-0-3. Prerequisite(s): AE 2020 or ME 3340.
Introduction to the study of blood flow in the cardiovasculcar system. Emphasis on modeling and the potential of flow studies for clinical research application. Crosslisted with CHE and ME 4757.

AE 4758. Biosolid Mechanics
3-0-3. Prerequisite(s): MATH 2403 and ME 3201.
The mechanics of living tissue, e.g., arteries, skin, heart muscle, ligament, tendon, cartilage, and bone. Constitutive equations and some simple mechanical models. Mechanics of cells. Applications. Crosslisted with CHE and ME 4758.

AE 4760. Engineering Acoustics and Noise Control
3-0-3. Prerequisite: MATH 2403.
Study of acoustics related to noise and its control; acoustics terminology wave propagation, wave equation solutions, instrumentation, data processing, room acoustics, noise control, noise legislation. Crosslisted with ME 4760.

AE 4791. Mechanical Behavior of Composites
3-0-3. Prerequisite: AE 3120, MSE 2001.
Stress-strain behavior of composites, property of matrix and reinforcing materials, mechanics of fiber-reinforced composites, lamina and laminate analysis, and mechanical performance. Crosslisted with CEE, CHE, ME, MSE, and TFE 4791.

AE 4793. Composite Materials and Processes
3-0-3. Prerequisite(s): CHEM 1211 and PHYS 2212.
Basic principles of selection and design of composite materials and their manufacturing and testing. Cost factors. Laboratory exercises on manufacturing and tests. Crosslisted with CEE, CHE, ME, MSE, and TFE 4793.

AE 4794. Composite Materials and Manufacturing and Testing
2-3-3. Prerequisite(s): CHEM 1211 and PHYS 2212.
Basic principles of selection and sign of composite materials and their manufacturing and testing. Cost factors. Laboratory exercises on manufacturing and tests. Crosslisted with CEE, CHE, ME, MSE, and TFE 4794.

AE 4801,-2,-3. Special Topics
Credit hours equal the last digit in course number
Normally taken by seniors. Course material devoted to special topics in aerospace engineering.

AE 4901,-2,-3. Special Problems
Credit hours to be arranged.
Research topic selected in consultation with advisor. A brief description, endorsed by the faculty advisor, must be approved by the School.

AE 6010. Shear Flow
3-0-3. Prerequisite: AE 3021.
Boundary layer theory; transition; physics of turbulence; turbulence modeling; shear flow control; recent developments.

AE 6020. High-Speed Flow
3-0-3. Prerequisite: AE 3021.
Transonic small disturbance theory. Transonic potential flow modeling. Supercritical airfoil design. Physics of hypersonic flow. Newtonian flow. Modeling of hypersonic viscous and inviscid flow.

AE 6030. Unsteady Aerodynamics
3-0-3. Prerequisite: AE 3021.
Unsteady potential theory for various speed ranges. Calculation of steady and unsteady aerodynamic loads on airfoils and wings. Vortex flows. Topics of current research interest.

AE 6042. Computational Fluid Dynamics
4-0-4. Prerequisite: AE 3450.
Finite-difference, finite volume methods for solution of Navier-Stokes and Euler equations. Classification of equations, stability, grids, boundary conditions, implicit and explicit methods, turbulence modeling.

AE 6050. Gas Dynamics
3-0-3. Prerequisite(s): AE 6765 or ME 6765.
Defining equations for compressible flows, real gas properties and their effect on the behavior of equilibrium and non-equilibrium flows.

AE 6052. Flow Diagnostics and Control
2-3-3. Prerequisite(s): AE 3021 and AE 3051
Introduction to experimental techniques; flow visualization; statistical methods; pressure, velocity, temperature, density, particle size, reaction rate measurements. Experiment design, data acquisition, and interpretation. Flow control.

AE 6060. Aeroacoustics
3-0-3. Prerequisite: AE 3021.
Lighthill's theory of aerodynamic noise and extensions, flow/acoustic interactions, feedback phenomenon, supersonic jet noise, aeroacoustics of ducts, propeller noise, helicopter noise, sonic boom.

AE 6070. Rotary Wing Aerodynamics
3-0-3. Prerequisite: AE 3021.
Vortex wake modeling; analytical inflow theories; modern computational methods for rotary wing aerodynamic analysis; aerodynamic noise.

AE 6080. Dynamics of Turbulence
3-0-3. Prerequisite(s): AE 6010.
Fundamental physics of turbulent flows. Vorticity dynamics, Kolmogorov similarity hypotheses and nonlinear interactions. Mixing and dispersion. Direct and large-eddy simulations, Reynolds stress modeling. Advanced topics.

AE 6100. Structural Stability I
3-0-3. Prerequisite(s): AE 3121.
Stability of elastic systems under quasi-static loads. Classical, kinetic, and potential energy approaches through rigid member models. Buckling of elastic bars and frames. Energy methods.

AE 6101. Structural Stability II
3-0-3. Prerequisite(s): AE 6100.
Buckling of beams on elastic foundations, rings and arches; elasticity theory; torsional buckling of shafts, buckling of plates, circular cylindrical shells, rotating beams, nonconservative problems.

AE 6103. Energy Methods
3-0-3. Prerequisite(s): AE 6110.
Virtual work and energy principles in solid mechanics, energy-based approximate numerical methods such as Rayleigh-Ritz, weighted residual and finite elements for analysis of structures and solids.

AE 6104. Computational Mechanics
3-0-3. Prerequisite(s): AE 6103.
Development of finite element methods for linear, static structural analysis. The basic tools of the finite element method. The formulation of various structural elements.

AE 6110. Elasticity I
3-0-3. Prerequisite(s): AE 2751 or ME 2751
Analysis of stresses and deformations in linear elastic media. Stress and equilibrium equations; strain and compatibility equations. Applications to two- and three-dimensional problems.

AE 6111. Elasticity II
3-0-3. Prerequisite(s): AE 6110.
Stresses and deformations in continuum media. Stress and strain measures used in nonlinear elasticity. Equilibrium equations and energy principles. Nonlinear beam, plate, and shell applications.

AE 6123. Design of Fiber-Reinforced Composite Structures
2-3-3. Prerequisite(s): AE 2751 or ME 2751.
Composite material systems, composite structures including anisotropic plate and shell theory, shear deformation, hygrothermal and interlaminar stresses. Finite element modeling. Design case studies and cost-effective applications for thin-walled sections.

AE 6161. Theory of Plates
3-0-3. Prerequisite(s): AE 3121
Development of isotropic and anisotropic plate theories. Classical and energy solutions for various geometrics and loadings. Aerospace applications including elastically coupled composite and sandwich plates.

AE 6162. Shell Structures
3-0-3. Prerequisite(s). AE 3120 and AE 6110.
Analysis of stresses and deformation of shells with and without bending. shells forming surfaces of revolution, asymptotic methods, buckling of shells, nonlinear theories.

AE 6165. Principles of Fracture and Fatigue
3-0-3. Prerequisite(s): AE 2751 or ME 2751.
Brittle and ductile fracture. Determination of stress intensity factors. Analytics of fracture mechanics. Elastic-plastic fracture. Energy release rate. Mechanics of fatigue. Crack growth. Environmental effects.

AE 6170. Structural Optimization
3-0-3. Prerequisite(s): AE 3121.
Mathematical methods of constrained optimization, sensitivity analysis, approximation concepts, decomposition techniques, shape optimization in the context of structural design.

AE 6200. Aeroelasticity
3-0-3. Prerequisite(s): AE 6030.
Understanding and analysis of aeroelastic phenomena in fixed-wing aircraft, static aeroelasticity, dynamic aeroelasticity, and dynamic response and transient stresses in aircraft structures.

AE 6210. Advanced Dynamics I
3-0-3. Prerequisite(s): AE 2220.
Kinematics of particles and rigid bodies, angular velocity, inertia properties, holonomic and nonholonomic constraints, generalized forces.

AE 6211. Advanced Dynamics II
3-0-3. Prerequisite(s): AE 6210.
A continuation of AE 6210. Equations of motion, Newtonian frames. consistent linearization, energy and momentum integrals, collisions, mathematical representation of finite rotation.

AE 6220. Rotorcraft Structural Dynamics and Aeroelasticity
3-0-3. Prerequisite(s): AE 6210 and AE 6230.
Elementary blade dynamics, flap-lag dynamics, ground resonance, structural dynamics of rotating beams, nonlinear elastic blade analysis, harmonic balance and trim, Floquet theory.

AE 6230. Structural Dynamics
3-0-3. Prerequisite(s): AE 3120, AE 3520.
Dynamic response of single-degree-of-freedom systems, Lagrange's equations; modal decoupling; vibration of Euler-Bernoulli and Timoshenko beams, membranes, and plates.

AE 6231. System Identification in Structural Dynamics
3-0-3. Prerequisite(s): AE 6230.
System identification by complex exponential methods, poly ref techniques, eigen-realization methods, and frequency domain methods. Effects of noise, generalized least squares, and recursive online identification.

AE 6240. Numerical Methods in Structural Dynamics
3-0-3. Prerequisite(s): AE 6230.
Rayleigh quotient, Rayleigh-Ritz and Galerkin methods; extraction of eigenvalues and eigenvectors; analysis of forced harmonic response; direct time integration of large-scale systems.

AE 6251. Experimental Methods in Structural Dynamics
2-3-3. Prerequisite(s): AE 6230.
Experimental methods for measurement of structural vibration, random vibration, analytical methods for analysis of vibration data, applications to single and multi-degree of freedom problems.

AE 6252. Smart Structures and Structural Control
2-3-3. Prerequisite(s): AE 6230.
Modeling smart sensors and actuators, development of closed-loop models, design of controllers, validation of controllers, application to vibration control, noise control, and shape control.

AE 6263. Flexible Multi-body Dynamics
3-0-3. Prerequisite(s): AE 6211 and AE 6230.
Nonlinear. flexible multi-body dynamic systems, parametrization of finite rotations, strategies for enforcement of holonomic and non-holonomic constraints, formulation of geometrically nonlinear structural elements, time-integration techniques.

AE 6270. Applied Nonlinear Dynamics
3-0-3. Prerequisite(s): AE 6230.
Nonlinear vibration methods through averaging and multiple scales, bifurcation, periodic and quasi-periodic systems, transition to chaos, characterization of chaotic vibrations, thermodynamics of chaos, chaos control.

AE 6280. Wave Propagation
3-0-3. Prerequisite(s): AE 6230.
Dilational, equivalue mixed waves; Rayleigh and Lamb waves, reflection, refraction, impact problems, plastic waves, N.D.E, vibration control, numerical methods, finite deformation wave propagation, constitutive equations.

AE 6320. Astronuatics
3-0-3. Prerequisite: AE 2220.
Introduction to the space environment, two-body orbital mechanics, rocket propulsion, performance, and staging. Interplanetary trajectories, atmospheric entry and heating, spacecraft communications. Credit not allowed for both AE 4380 and AE 6320.

AE 6322. Spacecraft Launch and Vehicle Design
2-6-4. Prerequisite(s): AE 6320
Conceptual design of spacecraft and launch vehicles. Emphasis on preliminary vehicle sizing and performance, effect of new technologies, and disciplinary interactions. Individual design projects.

AE 6331. Rotorcraft Design I
2-3-3. Prerequisite(s): AE 4070; Co-requisite: AE 6370.
Stochastic approach to conceptual design of aerospace systems with emphasis on rotorcraft. Comprehensive methodologies for aerospace vehicle synthesis and sizing. Integration of technologies.

AE 6332. Rotorcraft Design II
3-3-4. Prerequisite(s): AE 6331.
Students work together on this application to complete the preliminary design stage of a specific rotorcraft. Participants are exposed to disciplinary and interdisciplinary issues.

AE 6341. Fixed Wing Aircraft Design I
2-3-3. Prerequisite(s): AE 6370.
Stochastic approach to conceptual design of aerospace systems with emphasis on aircraft. Comprehensive methodologies for aerospace vehicle synthesis and sizing. Integration of technologies.

AE 6342. Fixed Wing Aircraft Design II
3-3-4. Prerequisite(s): AE 6341.
Students work together on this application to complete the preliminary design stage of a specific aircraft. Participants are exposed to disciplinary and interdisciplinary issues.

AE 6354. Advanced Orbital Mechanics
3-0-3. Prerequisite(s): AE 6320.
Advanced concepts in orbital mechanics including orbit determination, orbital perturbations, time of flight, rendezvous, low thrust trajectories, and multi-body problems. Taught in even-year spring semesters.

AE 6361. Air Breathing Propulsion System Design I
3-0-3. Prerequisite: CS 1301.
Air breathing propulsion design with emphasis on multidisciplinary design issues related to system integration, cycle selection, performance, cost, reliability, maintainability, etc.

AE 6362. Safety By Design
3-3-4. Prerequisite(s): AE 6320 or AE 6331 or AE 6341.
Autonomous situational flight model allows students to examine complex behaviors in the "pilot-vehicle-operational conditions" system. Flight certification and airworthiness requirements are mapped into formal scenarios.

AE 6370. Systems Design for Affordability through IPPD
4-0-4. Prerequisite: CS 1301.
Introduction to integrated product and process development and life cycle cost analysis. Systems engineering and quality engineering methods and tools. Top-down design decision support process. Computer-integrated environment and robust design simulation will be addressed.

AE 6371. Multidisciplinary Design Optimization
3-0-3. Prerequisite(s): CS 1301, MATH 2403.
Introduction to numerical optimization applied to the design of complex aerospace systems. Unconstrained and constrained optimization methods, stochastic methods, approximate methods, and multidisciplinary design optimization.

AE 6380. Fundamentals of Computer-aided Design and Engineering
3-0-3. Prerequisite(s): CS 1301 and MATH 2403.
Introduction to the principles of geometric modeling; 2-D systems; 3-D wireframe, surface and solid representations; mathematical representations of curves, surfaces, solids; application to aerospace design problems. Credit not allowed for both AE 4375 and AE 6380.

AE 6381. Software Development for Engineering Applications
2-3-3. Prerequisite: CS 1301.
Introduction to the development of engineering analysis and visualization software for UNIX workstations with emphasis on rapid prototyping, information modeling, distributed processing, and client/server architectures.

AE 6450. Rocket Propulsion
3-0-3. Prerequisite: AE 4451
Analysis and design of rocket engines including liquid, solid, hybrid, and advanced propulsion systems.

AE 6503. Helicopter Stability and Control
3-0-3. Prerequisite(s): AE 3520 and AE 4070.
Helicopter general equations of motion, rotor forces and moments, helicopter stability and control characteristics, handling qualities, flight control system design.

AE 6504. Modern Methods in Aircraft Flight Control
3-0-3. Prerequisite: AE 4520.
Linear quadratic regulator design. Model following control. Stochastic control. Fixed-structure controller design. Applications to aircraft flight control.

AE 6505. Random Processes and Kalman Filtering
3-0-3. Prerequisite: AE 3520.
Probability and random variables and processes; correlation; shaping filters; simulation of sensor errors; Wiener filter; random vectors; covariance propagation; recursive least-squares; Kalman filter; extensions.

AE 6506. Aerospace Guidance and Navigation
3-0-3. Prerequisite(s): AE 4520.
Earth's shape and gravity. Introduction to inertial navigation. GPS aiding. Error analysis. Guidance systems. Analysis of the guidance loop. Estimation of guidance variables. Adjoint analysis.

AE 6511. Optimal Guidance and Control
3-0-3. Prerequisite: MATH 2403.
Euler-Lagrange formulation; Hamilton-Jacobi approach; Pontryagin's minimum principle; systems with quadratic performance index; second variation and neighboring extremals; singular solutions; numerical solution techniques.

AE 6520. Advanced Flight Dynamics
3-0-3. Prerequisite: AE 3520.
Reference frames and transformations; general equations of unsteady motion; application to fixed wing, rotary wing, and space vehicles, stability characteristics; flight in turbulent atmosphere.

AE 6531. Aerospace Robust Control I
3-0-3. Prerequisite: AE 4520.
Robustness issues in controller analysis and design. LQ analysis, H2 norm, LQR, LQG, uncertainty modeling, small gain theorem, H-infinity performance, and the mixed-norm H2/H-infinity problem.

AE 6532. Aerospace Robust Control II
3-0-3. Prerequisite(s): AE 6531.
Advanced treatment of robustness issues. Controller analysis and design for linear and nonlinear systems with structured and non-structured uncertainty. Reduced-order control, stability, multipliers, and mixed-mu.

AE 6534. Control of Aerospace Structures
3-0-3. Prerequisite(s): AE 6531, AE 6230.
Advanced treatment of control of flexible structures. Topics include stability of multi-degree-of-freedom systems, passive and active absorbers and isolation, positive real models, and robust control for flexible stuctures.

AE 6580. Aerospace Nonlinear Control
3-0-3. Prerequisite: AE 4520.
Advanced treatment of nonlinear robust control. Lyapunov stability theory, absolute stability, dissipativity, feedback linearization, Hamilton-Jacobi-Bellman theory, nonlinear H-infinity, backstepping control, and control Lyapunov functions.

AE 6760. Acoustics I
3-0-3. Prerequisite(s): MATH 2403.
Fundamental principles governing the generation, propagation, reflection, and transmission of sound waves in fluids. Crosslisted with ME 6760.

AE 6761. Acoustics II
3-0-3. Prerequisite(s): AE 6760 or ME 6760.
Radiation and scattering of sound waves in fluids, duct acoustics, dissipation phenomena. Crosslisted with ME 6761.

AE 6762. Applied Acoustics
3-0-3. Prerequisite(s): AE 6760 or ME 6760.
Mufflers, resonators, acoustic materials, barriers, industrial noise, room acoustics, active noise control. Crosslisted with ME 6762.

AE 6765. Kinetics and Thermodynamics of Gases
4-0-4. Prerequisite(s): AE 3450 or ME 3322.
Thermodynamics of nonreacting and reacting gas mixtures. Introductory quantum theory, statistical thermodynamics, and gas kinetic theory. Crosslisted with ME 6765.

AE 6766. Combustion
3-0-3. Prerequisite(s): AE 6765 or ME 6765.
Introductory chemical kinetics, detonations and deflagrations, laminar flame propagation in premixed gases, ignition and quenching, laminar diffusion flames and droplet burning, turbulent reacting flows. Crosslisted with ME 6766.

AE 6767. Advanced Topics in Combustion
3-0-3. Prerequisite(s): AE 6766 or ME 6766.
Turbulent combustion, combustion instability and control, solid propellants and explosives, chemical kinetics, pollutant formation and destructiuon, computational and experimental methods for reacting flows. Crosslisted with ME 6767.

AE 6779. Dynamic System Simulation and Modeling
3-0-3. Prerequisite: AE 2220.
Models of dynamic systems, such as aircraft, ground vehicles, and machinery, and manual control. Numerical simulation techniques and applications. Interactive simulators. Student programming project. Crosslisted with ISYE 6779.

AE 7000. Master's Thesis
Credit hours to be arranged.

AE 7764. Acoustic Propagation
3-0-3. Prerequisite(s): AE 6760 or ME 6760.
Propagation of sound in inhomogeneous fluids; ray acoustics, ocean and atmospheric acoustics, nonlinear acoustics. Crosslisted with ME 7764.

AE 7772. Fundamentals of Fracture Mechanics
3-0-3. Prerequisite(s): ME 3201 or MSE 3005 or AE 3120.
Advanced study of failure of structural materials under load, mechanics of fracture, and microscopic and macroscopic aspects of the fracture of engineering materials. Crosslisted with CHE, CEE, ME, and MSE 7772.

AE 7773. Advanced Fracture Mechanics
3-0-3. Prerequisite(s): AE 7772 or CEE 7772 or CHE 7772 or ME 7772 or MSE 7772.
Nonlinear fracture mechanics including elastic-plastic and time-dependent fracture, advanced test methods, J-integral theory, and extensions. Crosslisted with CEE, CHE, ME, and MSE 7773.

AE 7774. Fatigue of Materials and Stuctures
3-0-3. Prerequisite(s): AE 7772 or CEE 7772 or CHE 7772 or ME 7772 or MSE 7772.
Mechanical and microstructural aspects of nucleation and growth of cracks under cyclic loading conditions, notch effects, cumulative damage, multiaxial loading, and fatigue crack propagation. Crosslisted with CEE, CHE, ME, and MSE 7774.

AE 7775. Topics in Fracture and Fatigue of Metallic and Composite Structures
3-0-3. Prerequisite(s): AE 2751 or ME 2751.
Brittle and ductile fracture criteria. Failure prediction in composite structures. Free-edge and internal delamination. Anisotropic cracks. Fatigue behavior of composites and metal. New micromechanical models. Crosslisted with CHE, ME, and MSE 7775.

AE 7791. Damage, Failure, and Durability of Composite Materials
3-0-3. Prerequisite(s): AE 4791 or CEE 4791 or CHE 4791 or ME 4791 or MSE 4791.
Analysis and failure of fiber-reinforced composite material systems. Mechanisms of toughening, multiple cracking mechanisms. Failure in woven fabric, braided and special geometry composites. Crosslisted with CHE, CEE, ME, MSE, and TFE 7791

AE 7792. Advanced Mechanics of Composites
3-0-3. Prerequisite(s): AE 7791 or CHE 7791 or CEE 7791 or ME 7791 or MSE 7791 or TFE 7791.
Anisotropic elasticity, hygrothermal behavior, stress analysis of laminated composites including 3D effects, stress concentrations, free-edge effects, thick laminates, adhesive and mechanical connections, fracture of composites. Crosslisted with CHE, CEE, ME, MSE, and TFE 7792.

AE 7793. Manufacturing of Composites
3-0-3. Prerequisite(s): AE 4794 or CEE 4794 or CHE 4794 or ME 4794 or MSE 4794 or TFE 4794.
Major manufacturing techniques of metal-ceramic and polymer-matrix composites. Modeling of processes with emphasis on fundamental mechanisms and effects. Crosslisted with CHE, CEE, ME, MSE, and TFE 7793.

AE 8001. Design Seminar
1-0-1.
Case studies of existing aerospace systems; assessment of design payoffs and risks; industry experts provide case examples and knowledge transfer to course participants; field trips.

AE 8800. Special Topics
3-0-3.
Special topics of current interest.

AE 8801,-2,-3. Special Topics
Credit hours equal the last digit in the course number.
Special topics of current interest.

AE 8900,-1,-2,-3. Special Problems
Credit hours to be arranged.

AE 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding graduate teaching assistantships.

AE 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding graduate research assistantships.

AE 8999. Preparation for Doctoral Dissertation
Credit hours to be arranged.

AE 9000. Doctoral Thesis
Credit hours to be arranged.

Georgia Tech/Emory School of Biomedical Engineering

Established in 1997
Location: Bioengineering and Bioscience Building
Telephone: (404) 385-0124
Fax: (404) 894-4243
E-mail: bme@bme.gatech.edu
Web address: www.bme.gatech.edu

Chair and Professor–P. Don Giddens; *Lawrence L. Gellerstedt Jr. Chair in Bioengineering and Professor of Medicine-Emory University, and Associate Chair and Regents' Professor*–Ajit Yoganathan; *Parker H. Petit Distinguished Chair for Engineering in Medicine and Professor, Mechanical Engineering*–Robert Nerem; *Professor*–Raymond P. Vito, Mechanical Engineering; *Associate Professors*–Paul J. Benkeser, Electrical and Computer Engineering; Stephen P. DeWeerth, Electrical and Computer Engineering; Athanassios Sambanis, Chemical Engineering; Timothy M. Wick, Chemical Engineering; Cheng Zhu, Mechanical Engineering; *Assistant Professors*–Gregory S. Berns, Psychiatry-Emory University; Robert S. Cargill, Mechanical Engineering; Elliot Chaikof, Surgery-Emory University; Zorina S. Galis, Cardiology-Emory University; Andres J. Garcia, Mechanical Engineering; Robert E. Guldberg, Mechanical Engineering; Michelle C. LaPlaca, GT/Emory Biomedical Engineering; Joseph M. LeDoux, GT/Emory Biomedical Engineering; Marc E. Levenston, Mechanical Engineering; Brian Litt, Neurology-Emory University; Mark Prausnitz, Chemical Engineering.

General Information

Georgia Tech has been involved in biotechnology-related research and education since the mid-1980s. In September 1997, after an intense planning and review process that involved faculty from both institutions, Georgia Tech joined with the Emory University School of Medicine to establish the GT/Emory School of Biomedical Engineering (BME). This new academic unit is a unique partnership between a public institution and a private university.

Georgia Tech and Emory are able to plan research and educational activities in an exceptionally comprehensive strategy because of this new BME School. Both universities have identified five thrust areas in which to focus research and faculty recruiting: Cardiovascular Biomechanics and Biology, Cellular and Tissue Engineering, Neurosciences/Engineering, Biomedical Imaging, and Biomedical Modeling and Computing.

Graduate Programs

Georgia Tech currently offers M.S. and Ph.D. degrees in bioengineering and participates in an M.D./Ph.D. degree program with Emory and the Medical College of Georgia. For the future, BME is developing a joint Georgia Tech/Emory Ph.D. degree in which curriculum tracks will emphasize depth in the research thrust areas.

All students pursuing the M.S. and Ph.D. degrees in bioengineering must apply for admission to the chair of the Bioengineering Program faculty, who is also the associate chair of the GT/Emory School of Biomedical Engineering. Students must indicate their preference for a "home" academic department, such as Biomedical Engineering, Chemical Engineering, or Mechanical Engineering, etc. Once admitted, the student may elect to pursue a graduate degree in bioengineering or a graduate degree in the home department with a research focus in bioengineering, thus allowing maximum flexibility. To fulfill degree requirements, students take a combination of courses in life sciences, bioengineering, traditional engineering subjects, and mathematics. While the following courses represent the current core of the bioengineering curriculum, new courses are constantly being developed, reflecting the expertise of the Georgia Tech/Emory faculty, and providing students with diverse educational opportunities.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

BIOMEDICAL ENGINEERING

BMED 6778. Introduction to Biomaterials
3-0-3.
Introduction to a variety of biomaterials and their biomedical applications. Crosslisted with CHE, ME, and TFE 6778.

BMED 6779. Bioprocess Engineering
3-0-3.
Study of enzymes and microbial and mammalian cells for production of biochemicals and protein therapeutics in bioreactors; downstream separation and purification; integrated view of bioprocesses. Crosslisted with CHE 6779.

BMED 6780. Medical Image Processing
3-0-3.
A study of methods for enhancing, analyzing, interpreting, and visualizing information from two- and three-dimensional data obtained from a variety of medical imaging modalities. Crosslisted with ECE and CS 6780.

BMED 6782. Cellular Engineering
3-0-3.
Engineering analysis of cellular systems. Crosslisted with CHE and ME 6782.

BMED 6783. Orthopaedic and Injury Biomechanics
3-0-3.
Structure-function relationships in a variety of tissues, with an emphasis on orthopaedic and neural systems through an understanding of mechanical, adaptational, and failure properties. Crosslisted with ME 6783.

BMED 6784. Cardiovascular Biomechanics
3-0-3.
Mechanical analysis of the cardiovascular system emphasizing the normal and pathologic function in relation to clinical cardiovascular medicine. Crosslisted with CHE and ME 6784.

BMED 6786. Medical Imaging Systems
3-0-3.
A study of the principles and design of medical imaging systems such as X-ray, ultrasound, nuclear medicine, and nuclear magnetic resonance. Crosslisted with ECE 6786.

BMED 6787. Quantitative Electrophysiology
3-0-3.
A quantitative presentation of electrophysiological systems in biological organisms, emphasizing the electrical properties and modeling of neural and cardiac cells and systems. Crosslisted with PHYS and ECE 6787.

BMED 6788. Legal Issues in Biomedical Engineering
3-0-3.
Study and analysis of U.S. government laws applicable to the development and clinical use of biomedical engineering technology. Crosslisted with ECE, CHE, ME, and MGT 6788.

BMED 6789. Technology Transfer in Biomedical Engineering
3-0-3.
Team discussion and case studies in biomedical engineering technology transfer, including licensing, financial capital, safety and efficacy studies, clinical trials, and strategic planning. Crosslisted with ECE, CHE, ME, and MGT 6789.

BMED 6793. Systems Pathophysiology
3-0-3.
Overview of human pathophysiology from a quantitative perspective. A brief introduction to the application of quantitative models to the understanding of biological systems. Crosslisted with CHE, ECE, and ME 6793.

BMED 6794. Tissue Engineering
3-0-3.
Biological, engineering, and medical issues in developing tissue-engineered constructs. Emphasis on the integration of these disciplines at a basic molecular and cell biology level. Crosslisted with CHE and ME 6794.

BMED 7000. Master's Thesis
Credit hours to be arranged.

BMED 9000. Doctoral Thesis
Credit hours to be arranged.

School of Chemical Engineering

Established in 1901
Location: Bunger-Henry Building
Telephone: (404) 894-2865
Fax: (404) 894-2866
Website: www.chemse.gatech.edu/

Chair and Professor–Ronald W. Rousseau; *Associate Chair and Professor*–F. Joseph Schork; *Associate Chair and Regents' Professor*–Amyn S. Teja; *J. Erskine Love Institute Chair in Engineering*–Charles A. Eckert; *Parker H. Petit Distinguished Chair for Engineering in Medicine*–Robert M. Nerem; *Regents' Professor*–Ajit Yoganathan; *Professors*–Agaram S. Abhiraman, Yaman Arkun, William R. Ernst, Dennis W. Hess, Jeffrey S. Hsieh, Paul A. Kohl, Charles L. Liotta, Michael J. Matteson, John D. Muzzy, Gary W. Poehlein, Robert J. Samuels, A.H. Peter Skelland, Jude T. Sommerfeld, Arnold F. Stancell, Mark G. White, Jack Winnick; *Professors Emeriti*–Charles W. Gorton, John E. Husted, Clyde Orr Jr., Henderson C. Ward; *Associate Professors*–Pradeep K. Agrawal, Sue A. Bidstrup Allen, Larry J. Forney, Ronnie S. Roberts, Thanassios Sambanis, Daniel W. Tedder, Timothy M. Wick; *Assistant Professors*–Clifford Henderson, Peter Ludovice, Jeffrey F. Morris, Mark Prausnitz, Matthew Realff, Mary Rezac; *Adjunct Professors*-Charlene W. Bayer, Elliott L. Chaikof, Yulin Deng, Peter Pfromm.

General Information

Chemical engineers perform essential functions in industries that convert raw materials into useful finished products by means of chemical and physical processes. Almost every major manufacturing industry employs chemical engineers in research, development, design, production, sales, consulting, and management positions. Industries that employ substantial numbers of chemical engineers include petroleum, petrochemical, pulp and paper, plastics, metallurgical, fiber, fertilizer, nuclear energy, space, rubber, food, photographic, heavy and fine chemical, mineral, pharmaceutical, textile, electronic, and dye. Energy problems and environmental and pollution control activities also require an increasing number of chemical engineers.

The School of Chemical Engineering offers programs leading to the Bachelor of Science in Chemical Engineering, Master of Science in Chemical Engineering, and Doctor of Philosophy. Interdisciplinary programs and undesignated degrees are also available.

Undergraduate Program

The following curriculum leads to the Bachelor of Science in Chemical Engineering and seeks to train students not only for positions immediately upon graduation, but also for additional study leading to the master's and doctoral degrees.

Chemical Engineering students may graduate with a maximum of one outstanding *D* in a required chemical engineering course. If a student accumulates more than one *D*, he or she is responsible for retaking these courses for a *C* or better. Students with more than one outstanding *D* in required chemical engineering courses will not be certified for graduation by the School. In addition, students who earn a grade of *D* in CHE 4520 MUST REPEAT THE COURSE. Also, a grade of *D* is not an acceptable passing grade for each of the four required mathematics courses (MATH 1501, 1502, 2401, and 2403).

A six-week summer study program in the Department of Chemical Engineering of the University College London in London, England, was initiated in 1975. Selected juniors who participate in this program are allowed 3 credit hours of free elective, as well as credit for CHE 4200 (Transport and Unit Operations Laboratory).

Students whose previous academic backgrounds differ substantially from that of Georgia Tech are strongly advised to consider lightened academic loads during their first several semesters at Tech.

Bachelor of Science in Chemical Engineering (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
MATH 1501	CALCULUS I	4
CHEM 1211	GENERAL CHEMISTRY	4
ENGL 1101	ENGLISH COMPOSITION I	3
HIST 2111 or 2112 or POL 1101 or	PUBP 3000 or INTA 1200	3
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS =		16

First Year - Spring Semester

Course Number/Name		*Hours*
MATH 1502	CALCULUS II	4
CHEM 1311	INORGANIC I	3
CHEM 1312	INORGANIC LAB	1
ENGL 1102	ENGLISH COMPOSITION II	3
PHYS 2211	PHYSICS I	4
CS 1301	COMPUTER SCIENCE I	3
TOTAL SEMESTER HOURS		18

Second Year - Fall Semester

Course Number/Name		*Hours*
MATH 2401	CALCULUS III	4
PHYS 2212	PHYSICS II	4
CHEM 3411	PHYSICAL CHEMISTRY I	3
CHE 2100	CHEM. PROCESS PRINCIPLES	3
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		17

Second Year - Spring Semester

Course Number/Name		*Hours*
MATH 2403	DIFF. EQUATIONS	4
CHEM 3412	PHYSICAL CHEMISTRY II	3
CHE 2110	CHE THERMODYNAMICS I	3
CHE 2120	CHE NUMERICAL METHODS	3
ECON 2100	ECONOMICS & POLICY	3
TOTAL SEMESTER HOURS		16

Third Year - Fall Semester

Course Number/Name		*Hours*
CHE 3110	CHE THERMODYNAMICS II	3
CHE 3200	TRANSPORT PROC. I	3
CHEM 2311	ORGANIC CHEMISTRY I	3
CHEM 3281	INSTRUMENTAL ANALYSIS	4
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		16

Third Year - Spring Semester

Course Number/Name		*Hours*
CHE 3210	TRANSPORT PROC. II	3
CHE 3220	UNIT OPERATIONS	3
CHEM 2312	ORGANIC CHEMISTRY II	3
CHEM 2380	SYNTHESIS LAB	2
HUMANITIES ELECTIVE		3
ECE 3710	CIRCUITS & ELECTRONICS	2
ECE 3741	INSTRUM. & ELECTRONICS LAB.	1
TOTAL SEMESTER HOURS		17

Fourth Year - Fall Semester

Course Number/Name		*Hours*
CHE 4200	TRANSPORT/UNIT OPS. LAB	3
CHE 4300	KINETICS & REACTOR DESIGN	3
CHE 4500	CHE DESIGN I	3
MSE 2100	ENG'R. MATERIALS	3
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		15

Fourth Year - Spring Semester

Course Number/Name		*Hours*
CHE 4400	CHEMICAL PROCESS CONTROL	4
CHE 4510	CHEMICAL PROCESS SAFETY	2
CHE 4520	CHE DESIGN II	2
CEE 2020	STATICS & DYNAMICS	3
FREE ELECTIVES		6
TOTAL SEMESTER HOURS		17

TOTAL PROGRAM HOURS = 130 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Electives

The chemical engineering curriculum contains 30 hours of electives to be chosen from 3 groups in the normal distribution indicated to satisfy the requirements of the School of Chemical Engineering: undesignated humanities electives (6 plus ENGL 1101 and 1102); social sciences (12 including 3 hours each in economics and history/political science); and free (6). Up to 9 hours of these electives may be taken on a pass/fail basis. Transfer students are restricted to fewer pass/fail hours. All students must satisfy a state requirement regarding course work in the history and constitutions of the U.S. and Georgia by taking one of the following: HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200. A listing of acceptable humanities and social science electives can be found on pages 33-34.

Free Electives

Six hours of free electives are provided so that a student will be able to pursue specific interests. See the ROTC and Health and Performance Sciences credit sections for the maximum hours in these areas that may be applied toward degree requirements. No course covering the same material as other courses in a student's plan of study may be used as a free elective.

Minor in Materials Science and Engineering

Materials are the enabling basis for almost all other engineering and scientific disciplines. The purpose of this minor is to broaden the materials background of nonmaterial majors and to introduce them to a materials approach to problemsolving that is different from that provided by their major. Undergraduate students who desire a more extensive understanding of materials should consider completing a minor program of study in Materials Science and Engineering. (Additional information is available from the School of Materials Science and Engineering.)

Graduate Programs

The School of Chemical Engineering offers graduate programs of advanced study and research leading to the master of science and the doctor of philosophy degrees, both involving a combination of advanced-level courses and independent research.

All degree candidates must complete a research thesis. Course selection for both the master's and doctoral degrees is quite flexible, with individual plans of study developed for each student. Research opportunities exist in a broad range of areas of importance to chemical engineers and society, including air pollution control, biochemical engineering, polymer science, process design and simulation, catalysis, chemical reaction engineering, biomedical engineering, pulp and paper engineering, transport phenomena, fine particle technology, thermodynamics, electrochemical engineering, process control, and microelectronics. The School of Chemical Engineering participates with several other schools in offering the M.S. and Ph.D. in bioengineering and in polymers.

Multidisciplinary Programs

See table on page 122.

Courses of Instruction

Figures entered below the course number and title of each course signify the number for class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

CHEMICAL ENGINEERING

CHE 1750. Introduction to Bioengineering
3-0-3.
An introduction to the field of bioengineering, including the application of engineering principles and methods to problems in biology and medicine, the integration of engineering with biology, and the emerging industrial opportunities. Crosslisted with AE, ECE, ME, and MSE 1750.

CHE 2100. Chemical Process Principles
3-0-3. Prerequisite: CHEM 1211.
Material and energy balances for single-phase and multi-phase processes common to chemical engineering. Phase equilibrium and analysis of reacting systems.

CHE 2110. Chemical Engineering Thermodynamics I
3-0-3. Prerequisite: CHE 2100; Co-requisite: CHE 2120.
Elements of engineering thermodynamics. First and second laws. Analysis of engineering machinery: compressors, turbines, engineer, refrigeration.

CHE 2120. Numerical Methods in Chemical Engineering
3-0-3. Prerequisite(s): CHE 2100 and MATH 1502.
Numerical methods are introduced and applied to the solution of chemical engineering problems. An introduction to chemical process simulation, and the appropriate software is provided.

CHE 3110. Chemical Engineering Thermodynamics II
3-0-3. Prerequisite(s): CHE 2110 and CHE 2120.
Phase and chemical reaction equilibria. Vapor-liquid, liquid-liquid, and solid-vapor phase equilibrium. Fugacity and activity coefficients. Multi-reaction equilibrium.

CHE 3200. Transport Process I
3-0-3. Prerequisites: CHE 2100 and CHE 2110.
Fundamentals of fluid mechanics and heat transfer. The design and analysis of equipment using the principles of fluid mechanics and heat transfer.

CHE 3210. Transport Processes II
3-0-3. Prerequisite: CHE 3200.
Fundamental principles and applications of mass transfer. The analysis of chemical engineering processes and operations involving mass transfer.

CHE 3220. Unit Operations
3-0-3. Prerequisite: CHE 3110.
Fundamentals of equilibrium stage operations. Design and operation of plate distillation columns, absorbers, strippers, and liquid-liquid extraction columns.

CHE 3600. Engineeering Ethics and Leadership
3-0-3.
Development of quantitative and qualitative assessment tools to resolve moral and ethical dilemmas that arise in the performance of engineering duties.

CHE 4200. Transport Phenomena/Unit Operations Laboratory
2-3-3. Prerequisite: CHE 3220; Co-requisite: CHE 4300.
This course illustrates engineering/scientific principles and physical models important to the data collection/ interpretation of processes important to the practice of chemical engineering.

CHE 4300. Kinetics and Reactor Design
3-0-3. Prerequisites: CHE 3110 and CHE 3210.
Reacting systems are analyzed in terms of reaction mechanisms, kinetics, and reactor design. Both homogeneous and heterogeneous reactions are considered.

CHE 4400. Chemical Process Control
3-3-4. Co-requisite: CHE 4300.
Dynamics of chemical processes and their control. Techniques of conventional process control as well as digital control. Laboratory experiments to illustrate these concepts.

CHE 4500. Chemical Engineering Design I
3-0-3. Prerequisite: CHE 3220; Co-requisite: CHE 4300.
Principles of chemical flowsheet synthesis and economic optimization. Economic and design concepts will be introduced and used to synthesize and optimize various chemical processes.

CHE 4510. Chemical Process Safety
2-0-2. Prerequisite: CHE 4500; Co-requisite: CHE 4520.
This course discusses the fundamental sources of chemical hazards and degree of risk. Process design and hazard avoidance are used to reduce risk.

CHE 4520. Chemical Engineering Design II
1-2-2. Prerequisite: CHE 4500; Co-requisite: CHE 4510.
Complete design of a chemical process and plant incorporating concepts of unit operations, design, economics, safety, and process control.

CHE 4571. Pulping and Chemical Recovery
3-0-3.
Pulping and chemical recovery processes are studied on the reaction, delignification, energy, and liquor reuse. The process optimization, air and water pollution minimization are taught.

CHE 4572. Bleaching and Papermaking
3-0-3.
Pulp bleaching and formation of paper/board products are studied along with testing, end uses, chemical and mechanical treatment of pulp, nonwood and recycled fiber utilization.

CHE 4573. Pulping and Bleaching Laboratory
0-6-2.
Experiments of pulping, bleaching, fiber and chemical testing are performed. Hands-on experience from chip preparation, cooking, pulp processsing, and bleaching are provided.

CHE 4574. Papermaking and Recycled Pulp Laboratory
0-6-2.
Experiments of pulp preparation, refining, paperforming, handsheet testing, deinking, and recycled pulp processing are performed. Small papermachine operation will be taught.

CHE 4600. Effective Communication for Professional Engineering
3-0-3.
How engineers communicate with engineering and nonengineering professionals. Industry speakers from different fields. Engineering case study. Weekly written and/or oral presentations.

CHE 4752. Integrated Circuit Fabrication
2-3-3. Prerequisite: ECE 3040.
The objective of this course is to give students exposure to the various steps involved in the fabrication of integrated circuits and devices. This course will include a laboratory segment in which students fabricate MOS transistors, diffused resistors, and MOS capacitors from a bare silicon substrate. Crosslisted with CHE 4752.

CHE 4757. Biofluid Mechanics
3-0-3. Prerequisite: AE 2020 or ME 3340.
Introduction to the study of blood flow in the cardiovasuclar system. Emphasis on modeling and the potential of flow studies for clinical research application. Crosslisted with AE and ME 4757.

CHE 4758. Biosolid Mechanics
3-0-3. Prerequisites: MATH 2403 and ME 3201.
The mechanics of living tissue, e.g., arteries, skin, heart muscle, ligament, tendon, cartilage, and bone. Constitutive equations and some simple mechanical models. Mechanics of cells. Applications. Crosslisted with AE and ME 4758.

CHE 4775. Polymer Science and Engineering I: Formation and Properties
3-0-3. Prerequisites: CHEM 2312 and CHEM 3411.
An introduction to the chemistry, structure, and formation of polymers, physical states and transitions, physical and mechanical properties of polymer fluids and solids. Crosslisted with CHEM, ME, MSE, and TFE 4775.

CHE 4776. Polymer Science and Engineering II: Analysis, Processing, and Laboratory
1-6-3. Prerequisite(s): CHE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or TFE 4775.
Polymer fabrication processes and methods of characterization anad identification of polymers are presented. Experiments in polymerization, processing, and property evaluation of polymers. Crosslisted with CHEM, ME, MSE, and TFE 4776.

CHE 4781. Biomedical Instrumentation
3-0-3.Prerequisite: ECE 3050.
A study of medical instrumentation from a systems viewpoint. Pertinent physiological and electro-physiological concepts will be covered. Crosslisted with ECE and ME 4781.

CHE 4782. Biosystems Analysis
3-0-3. Prerequisite: MATH 1502.
Analytical methods for modeling biological systems, including white-noise protocols for characterizing nonlinear systems. Crosslisted with ECE and ME 4782.

CHE 4791. Mechanical Behavior of Composites
3-0-3. Prerequisite: ME 3311.
Stress-strain behavior of composites, property of matrix and reinforcing materials, mechanics of fiber-reinforced composites, lamina and laminate analysis, and mechanical performance. Crosslisted with AE, CEE, ME, MSE, and TFE 4791.

CHE 4793. Composite Materials and Processes
3-0-3. Prerequisites: CHEM 1211 and PHYS 2212.
Basic principles of selection and design of composite materials and their manufacturing and testing. Cost factors. Laboratory exercises on manufacturing and tests. Crosslisted with AE, CEE, ME, MSE, and TFE 4793.

CHE 4794. Composite Materials and Manufacturing
2-3-3. Prerequisites: CHEM 1211 and PHYS 2212.
Basic principles of selection and design of composite materials and their manufacturing and testing. Cost factors. Laboratory exercises on manufacturing and tests. Crosslisted with AE, CEE, ME, MSE, and TFE 4794.

CHE 4801,-2,-3,-4,-5,-6. Special Topics
Credit hours equal the last digit in course number.
Topics relevant to chemical engineering not currently covered in the undergraduate curriculum are presented as demand or interest warrants.

CHE 4901,-2,-3. Special Problems
Credit hours to be arranged.
The student is given an opportunity to develop initiative and to apply fundamental principles by doing semioriginal laboratory or theoretical investigation of a chemical engineering problem.

CHE 6003. Chemical Process Safety
1-0-1.
The course focuses on risk reduction through design and hazard avoidance. Sources of chemical hazards and risks.

CHE 6004. Communication Skills for Technical Problem Solving
0-3-1.
Applications of both written and oral communication skills to the solution of technical problems. Includes focus, audience analysis, visual aids, and organization.

CHE 6100. Advanced Chemical Engineering Thermodynamics
3-0-3.
Equations of state, corresponding states, and activity coefficient models and their relationship to intermolecular forces. Phase and chemical equilibria in chemical engineering.

CHE 6110. Thermodynamics of Systems of Large Molecules
3-0-3. Prerequisite: CHE 6100
Classical and statistical thermodynamics of systems that are important in chemical, biochemical, and polymer processing.

CHE 6120. Molecular Modeling
3-0-3.
Introduction to computational chemistry techniques for modeling substances at the molecular level, including: ab initio and semiempirical quantum methods, molecular dynamics, and Monte Carlo methods.

CHE 6130. Electrochemical Engineering
3-0-3.
Electrochemical thermodynamics and kinetics. Corrosion. Applications to semiconductor devices, fuel cells, and batteries.

CHE 6200. Advanced Transport Phenomena, Fluid Mechanics, and Heat Transfer
3-0-3.
Viscous fluid mechanics and convective heat transfer. Scaling analysis and lubrication. Stokes and boundary layer flows. Transport about solid bodies. Linear stability theory.

CHE 6210. Fluid Mechanics of Two-Phase Flow
3-0-3. Prerequisite(s): CHE 6200.
Two-phase flow of nondeformable particles in Newtonian fluids. Rigorous results in the limit of small Reynolds number motions and applications to suspensions and colloids.

CHE 6220. Computational Fluid Dynamics: Applications in Environmental and Chemical Processes
2-3-3. Prerequisite(s): CHE 6200.
Introduction to numerical methods for solving transport problems. Applications to problems of interest in environmental and chemical processes.

CHE 6230. Industrial Emissions Control
3-0-3.
Analysis of air quality criteria, ambient and emission standards, and industrial pollution sources. Recovery and utilization of waste gases and particulate matter.

CHE 6240. Advanced Separation Processess
3-0-3.
Advanced analysis of separation process technology, with special emphasis on new separation techniques, applications.

CHE 6250. Mass Transport through Solids
3-0-3.
An indepth introduction to transport of penetrants in and through solids. Convective flow through porous media, and conductive flow through homogenous solids. Membrane separations.

CHE 6300. Kinetics and Reactor Design
3-0-3.
A study of chemical kinetics and mechanisms in complex homogeneous and heterogeneous reaction systems. Design and analysis of chemical reactors for such systems.

CHE 6310. Applied Chemical Kinetics
3-0-3.
Applications of chemical kinetics to homogeneous and heterogeneous gas and liquid reactions, including techniques and analyses.

CHE 6320. Heterogeneous Catalysis
3-0-3. Prerequisite(s): CHE 6300
Physics and chemistry of surfaces; thermodynamics, kinetics, and mechanism of adsorption and surface reactions; modern instrumental analyses, and industrial catalysis.

CHE 6400. Advanced Process Control
3-0-3.
Fundamentals of multivariate control theory as applied to chemical processes.

CHE 6410. Dynamic Behavior of Process Systems
2-3-3.
Introduction to process dynamics. Modeling of lumped systems with and without chemical reactions. Lumped processes involving phase equilibrium. Distributed parameter systems. Optimization of transient processes.

CHE 6600. Polymerization Reaction Engineering
3-0-3.
Polymerization processes are analyzed with regard to reaction mechanism, kinetics, and reactor design. Control of polymer structure during polymerization is emphasized.

CHE 6609. Polymers in Microelectronics
3-0-3.
Use of polymers in microelectronics applications such as photolithography, interlevel dielectrics, encapsulation, packaging, magnetic media, and optical storage.

CHE 6750. Preparation and Reactions of Polymers
3-0-3. Prerequisite(s): CHE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or TFE 4775.
A detailed treatment of the reactions involved in the synthesis of both man-made and natural polymers, including preparation and degradative reactions of polymer systems. Crosslisted with CHEM and TFE 6750

CHE 6751. Physical Chemistry of Polymer Solutions
3-0-3. Prerequisite(s): (CHE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or TFE 4775) or (ME 4777 or MSE 4777 or TFE 4777).
Study of polymer solutions, polymer miscibility, adsorption, sorption, plasticization, molecular weights, molecular weight distributions, and interfacial phenomena using thermodynamics and statistical mechanics. Crosslisted with CHEM, MSE, and TFE 6751.

CHE 6752. Polymer Characterization
3-3-4. Prerequisite(s): (CHE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or TFE 4775) or (ME 4777 or MSE 4777 or TFE 4777)
This course introduces the student to surface, near-surface, and structural methods of polymer characterization. Specialized techniques critical to physical structure are emphasized. Crosslisted with CHEM, MSE, and TFE 6752.

CHE 6759. Plasma Processing of Electronic Materials and Devices
3-0-3.
Fundamental physics, chemistry, chemical engineering, and electrical engineering principles inherent in plasma processes. Includes etching, deposition, diagnostic methods, and control schemes. Crosslisted with ECE 6759.

CHE 6768. Polymer Structure, Physical Properties, and Characterization
3-0-3. Prerequisite(s): CHE 4776 or CHEM 4776 or ME 4776 or MSE 4776 or TFE 4776.
Formulations and analysis of molecular and phenomenological models of elastic and viscoelastic behavior, development and description of structure, and fundamental aspects of structure-property relations. Crosslisted with ME, TFE, and MSE 6768.

CHE 6778. Introduction to Biomaterials
3-0-3.
Introduction to a variety of biomaterials and their biomedical applications. Crosslisted with BMED 6778.

CHE 6779. Bioprocess Engineering
3-0-3.
Study of enzymes and microbial and mammalian cells for production of biochemicals and protein therapeutics in bioreactors; downstream separation and purification; integrated view of bioprocesses. Crosslisted with BMED 6779.

CHE 6782. Cellular Engineering
3-0-3.
Engineering analysis of cellular systems. Crosslisted with BMED and ME 6782

CHE 6784. Cardiovascular Biomechanics
3-0-3.
Mechanical analysis of the cardiovascular system emphasizing the normal and pathologic function in relation to clinical cardiovasuclar medicine. Crrosslisted with BMED and ME 6784.

CHE 6788. Legal Issues in Biomedical Engineering
3-0-3.
Study and analysis in U.S. government laws applicable to the development and clinical use of biomedical engineering technology. Crosslisted with BMED, ECE, ME, and MGT 6788.

CHE 6789. Technology Transfer in Biomedical Engineering
3-0-3.
Team discussion and case studies in biomedical engineering technology transfer, including licensing, financial capital, safety and efficacy studies, clinical trials, and strategic planning. Crosslisted with BMED, ECE, ME, and MGT 6789.

CHE 6793. Systems Pathophysiology
3-0-3.
Overview of human pathophysiology from a quantitative perspective. A brief introduction to the application of quantitative models to the understanding of biological systems. Crosslisted with BMED, ECE, and ME 6763.

CHE 6794. Tissue Engineering
3-0-3.
Biological, engineering, and medical issues in developing tissue-engineered constructs. Emphasis on the integration of these disciplines at a basic molecular and cell biology level. Crosslisted with CHE and ME 6794.

CHE 7000. Master's Thesis
Credit hours to be arranged

CHE 7650. Advanced Physical Chemistry of Polymers
3-0-3. Prerequisite(s): CHEM 6422 and CHE 6751 or CHEM 6751 or MSE 6751 or TFE 6751.
Thermodynamics and microscopic dynamics of polymers. Fundamental concepts, including scaling concepts, governing anisotropy of polarizability, phase transitions, morphology, time-dependent correlations, etc.

CHE 7771. Mechanics of Polymer Solids and Fluids
3-0-3.
Continuum mechanics of solids and fluids; mechanics of deformation of anisotropic polymers; yield, breaking, and fatigue; non-Newtonian viscous and viscoelastic behavior of polymer fluids. Crosslisted with ME, MSE, and TFE 7771.

CHE 7772. Fundamentals of Fracture Mechanics
3-0-3. Prerequisite(s): ME 3201 or MSE 3005.
Advanced study of failure of structural materials under load, mechanics of fracture, and microscopic and macroscopic aspects of the fracture of engineering materials. Crosslisted with AE, CEE, ME, and MSE 7772.

CHE 7773. Advanced Fracture Mechanics
3-0-3. Prerequisite(s): AE 7772 or CEE 7772 or CHE 7772 OR ME 7772 or MSE 7772.
Nonlinear fracture mechanics including elastic-plastic and time-dependent fracture, advanced test methods, J-integral theory, and extensions. Crosslisted with AE, CEE, ME, and MSE 7773.

CHE 7774. Fatigue of Materials and Structures
3-0-3. Prerequisite(s): AE 7772 or CEE 7772 or CHE 7772 or ME 7772 or MSE 7772.
Mechanical and microstructural aspects of nucleation and growth of cracks under cyclic loading conditions, notch effects, cumulative damage, multiaxial loading and fatigue, crack propagation. Crosslisted with AE, CEE, ME, and MSE 7774.

CHE 7775. Topics in Fracture and Fatigue of Metallic and Composite Structures
3-0-3. Prerequisite(s): AE 2751 or ME 2751.
Brittle and ductile failure criteria. Failure prediction in composite structures. Free-edge and internal delamination. Anisotropic cracks. Fatigue behavior of composites and comparison with metal fatigue. Crosslisted with AE, ME, and MSE 7775.

CHE 7791. Damage, Failure, and Durability of Composite Materials
3-0-3. Prerequisite(s): AE 4791 or CEE 4791 or CHE 4791 or ME 4791 or MSE 4791.
Provides knowledge of the fundamental concepts and methods related to analysis and assessment of damage, failure, and durability of composite materials. Crosslisted with AE, CEE, ME, MSE, and TFE 7791.

CHE 7792. Advanced Mechanics of Composites
3-0-3. Prerequisite(s): CHE 4791 and CEE 6321.
Anisotropic elasticity, failure theories, hydrothermal behavior, 3-D analysis of laminates, thick laminates, free-edge effects, stress concentrations, joints, creep, and fracture of composites, and advanced topics. Crosslsited with AE, CEE, ME, MSE, and TFE 7792.

CHE 7793. Manufacturing of Composites
3-0-3. Prerequisite(s): CHE 4793.
Major manufacturing techniques for metal, ceramic, and polymer matrix composites. Modeling of processes with emphasis on fundamental mechanisms and effects. Crosslisted with AE, CEE, ME, MSE, and TFE 7793.

CHE 8001,-2. Seminar in Chemical Engineering
1-0-1, each.

CHE 8801,-2,-3,-4. Special Topics
3-0-3, each.

CHE 8901. Special Problems
Credit hours to be arranged

CHE 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding teaching assistantships.

CHE 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding research assistantships.

CHE 9000. Doctoral Thesis
Credit hours to be arranged

School of Civil and Environmental Engineering

Established in 1896
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Website: www.ce.gatech.edu

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Engineers II–Joseph Dove, Michael Lee, Rami Nagib, Huaming Yao, Hamid Zand; *Research Engineers I*–Robert S. Abernathy, P. Klochko, Zhiyong Liu, Jen. Ogle; *Principle Research Scientist*–Michael O. Rogers; *Senior Research Scientist*–Michael Young; *Research Scientists II*–Mikhail Folgelson, Thomas Malecki, Stacy V. Stringer, Jing Zhi Zhao, Guangxuan Zhu; *Research Scientists I*–Layla Raad, Derrick Whittle; *Research Associate II*–Leisha Dehart-Davis; *Research Associates I*–Mary Beth Canon, David Key.

General Information

The School of Civil and Environmental Engineering offers courses in civil engineering, environmental engineering, engineering science and mechanics, as well as engineering computer graphics and programs leading to the degrees Bachelor of Science in Civil Engineering, Master of Science in Civil Engineering, Master of Science in Engineering Science and Mechanics, Master of Science in Environmental Engineering, Master of Science (undesignated), and Doctor of Philosophy. Also offered is a program leading to the degrees Master of Science in Civil Engineering or Master of Science (undesignated), major in transportation engineering, and Master of City Planning.

Undergraduate Program

Bachelor of Science

The four-year curriculum leading to the Bachelor of Science in Civil Engineering (BSCE) enables the graduate to enter professional practice as an engineer or to continue his or her studies in programs leading to advanced degrees in the following broad fields of specialization: construction engineering and management, environmental engineering, environmental hydraulics, geotechnical engineering, hydrology, materials, structural engineering and mechanics, transportation, and water resources planning and management. The Bachelor of Science in Civil Engineering degree program is designed to offer depth in course material considered essential for all civil and environmental engineers, as well as flexibility in selecting elective courses that offer breadth of topic exposure. Civil engineers contribute to society in numerous ways; thus, the School's philosophy is to provide the student with a range of electives that meet student interests. Civil engineers must not only be technically proficient, but also must be effective in working with people and with professionals in other disciplines. Accordingly, the School faculty have adopted the following objectives for the undergraduate degree program: 1) provide an educational experience that prepares our students for the challenges of the civil and environmental engineering profession that they will face during their professional careers; 2) promote scholarship and problem-solving skills in the curriculum; 3) provide opportunities for students to exhibit leadership and team-building skills; 4) promote service to the profession and to society; 5) incorporate interdisciplinary concepts and problem-solving exercises into educational programs; and 6) provide exposure to the civil and environmental engineering technologies of today and those likely of tomorrow. The Bachelor of Science in Civil Engineering degree is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology. Graduates of the BSCE curriculum are eligible to seek licensing as registered professional engineers.

The course requirements of the Bachelor of Science in Civil Engineering degree are listed in the following pages. Although students do not have to take the courses during the semester indicated, they must satisfy all prerequisites for a particular course.

In addition to campuswide academic requirements for graduation with a bachelor's degree, the following are also required for the BSCE degree.

(a) A grade of *C* or better must have been earned in MATH 1501-1502, PHYS 2211, BIOL 1510, CHEM 1211, and CEE 2020.

(b) The number of quality points earned in civil engineering courses taken toward the degree must be at least twice the number of credit hours in those courses. If a course is repeated, the latest grade will be included in applying this rule. No CEE course may be repeated for the purpose of satisfying this rule if the original grade was a *C* or higher.

Joint BS/MS Degree Program

The American Society of Civil Engineers has adopted a policy of urging students to obtain a master's degree as the entry-level degree in the profession. The faculty of the School of Civil and Environmental Engineering have concluded that in many civil engineering program areas, a master's degree is necessary for students to have sufficient background to be successful professionally. The School allows students who are admitted to the master's degree program to use six credit hours of graduate-level course work (CEE 6000 or higher) in the major discipline for both degrees. In order to qualify for this option, the student must complete the undergraduate degree with a cumulative grade point average of 3.5 or higher and complete the master's degree within two years after the award date of the bachelor's degree.

Bachelor of Science in Civil Engineering (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
MATH 1501	CALCULUS I	4
CHEM 1211	GENERAL CHEMISTRY	4
ENGL 1101	ENGLISH COMPOSITION I	3
CS 1301	COMPUTER SCIENCE I	3
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		17

First Year - Spring Semester

Course Number/Name		*Hours*
MATH 1502	CALCULUS II	4
PHYS 2211	PHYSICS I	4
ENGL 1102	ENGLISH COMPOSITION II	3
ME/CEE 1770	ENGR. GRAPHICS	3
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS		16

Second Year - Fall Semester

Course Number/Name		*Hours*
MATH 2401	CALCULUS III	4
PHYS 2212	PHYSICS II	4
CEE 2000	APPLICATIONS PROB/STATISTICS	1
CEE 2010	COMPUTATIONAL MODELING	3
ISYE/MATH 3770	INTRO. TO PROB./STATISTICS	3
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		18

Second Year - Spring Semester

Course Number/Name		*Hours*
MATH 2403	DIFF. EQUATIONS	4
BIOL 1510	BIOL. PRINCIPLES	4
CEE 2020	STATICS & DYNAMICS	3
ECON 2100	ECONOMIC ANALYSIS	3
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		17

Third Year - Fall Semester

Course Number/Name		*Hours*
CEE 3000	CE SYSTEMS	3
CEE 3020	CE MATERIALS	3
CEE 3030	STRENGTH OF MATERIALS	3
EAS 2601	EARTH PROCESSES	4
ME 3322 OR CHE 2100		3
TOTAL SEMESTER HOURS		16

Third Year - Spring Semester

Course Number/Name		*Hours*
CEE 3010	GEOMATICS	3
CEE 3040	FLUID MECHANICS	3
CEE 3050	STRUCTURAL ANALYSIS	3
PST 3109	ETHICS	3
ENGINEERING ELECTIVE		3
TOTAL SEMESTER HOURS		15

Fourth Year - Fall Semester

Course Number/Name		*Hours*
CEE 4100	CONSTRUCTION ENGINEERING	3
CEE 4200	HYDRAULIC ENGINEERING	3
CEE 4300	ENVIRONMENTAL SYSTEMS	3
CEE 4400	GEOSYSTEMS ENGINEERING	3
CEE ELECTIVE		3
APPROVED ELECTIVE		3
TOTAL SEMESTER HOURS		18

Fourth Year - Spring Semester

Course Number/Name		*Hours*
CEE 4600	TRANSP. PLAN. & DESIGN	3
CP 4030	CITY & TECHNOLOGY	3
CEE ELECTIVE		3
APPROVED ELECTIVE		3
CEE ELECTIVE (DESIGN)		3
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 130 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Electives

Humanities/Social Sciences

A total of 12 credit hours of humanities and 12 credit hours of social sciences are required. Humanities consists of ENGL 1101, ENGL 1102, a 3-hour humanities elective*, and PST 3109. Social Sciences consist of a U.S./Government course, ECON 2100, a 3-hour social science elective*, and CP 4030. All courses taken to satisfy humanities and social sciences must be taken on a letter-grade basis.

To satisfy the state requirements regarding course work in the history and constitutions of the U.S. and Georgia, students must complete one of the following courses: HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200.

*See pages 33-34 for a list of acceptable courses.

Technical Electives

There are 15 hours of elective credit in the senior year. Students may use these electives to pursue a specific area of interest within Civil and Environmental Engineering. A maximum of 6 hours, with faculty approval, may be chosen from outside the School of Civil and Environmental Engineering.

CEE	4110	Construction Planning, Estimating, and Scheduling (3-0-3)
CEE	4120	Construction Equipment and Methods (3-0-3)
CEE	4210	Hydrology (3-0-3)
CEE	4220	Environmental Transport Processes (3-0-3)
CEE	4310	Water Quality Engineering (3-0-3)
CEE	4320	Hazardous Substance Engineering (3-0-3)
CEE	4420	Subsurface Characterization (2-3-3)
CEE	4430	Environmental Geotechnics (3-0-3)
CEE	4550	Structural Analysis II (3-0-3)
CEE	4620	Environmental Impact Assessment (3-0-3)
CEE	4791	Mechanical Behavior of Composites (3-0-3)
CEE	4793	Composite Materials and Processes (3-0-3)
CEE	4900	Undergraduate Honors Research Project

Design Electives

CEE	4390	Environmental Engineering Facilities Design (2-3-3)
CEE	4410	Geosystems Engineering Design (3-0-3)
CEE	4510	Structural Steel Design (3-3-4)
CEE	4520	Reinforced Concrete Design (3-0-3)
CEE	4530	Timber and Masonry Design (3-0-3)
CEE	4540	Infrastructure Rehabilitation (2-3-3)
CEE	4610	Multimodal Transportation Planning, Design, and Operations (3-0-3)
CEE	4630	Computer-Aided Site and Roadway Design (2-3-3)

Other requirements include additional CEE courses and approved courses from other units.

Graduate Program

Master of Science

Four master's degrees are available in the School of Civil and Environmental Engineering. M.S. programs are available in the areas of construction engineering and management, environmental engineering, environmental hydraulics and water resources, geosystems, structures and mechanics, and transportation. The four master's degrees are described below:

Master of Science in Civil Engineering

Students seeking this degree must have previously earned a BSCE or its equivalent.

a. Course option

Required Courses in Major Area of Specialization (Construction Management, Environmental, Geosystems, Structures and Mechanics, Transportation, Water Resources)	18
Approved Electives	12
Semester Hours	30*

b. Thesis option

Required Courses in Major Area of Specialization	12
(Construction Management, Environmental, Geosystems, Structures and Mechanics, Transportation, Water Resources)	
Approved Electives	12
Thesis	6
Semester Hours	30**

Master of Science in Engineering Science and Mechanics

Students seeking this degree must have a B.S. in engineering or the physical sciences.

a. Course option

Required Courses in Mechanics	18
Mathematics	6
Approved Electives	6
Semester Hours	30*

b. Thesis option

Required Courses in Mechanics	12
Mathematics	6
Approved Electives	6
Thesis	6
Semester Hours	30**

Master of Science in Environmental Engineering

The degree Master of Science in Environmental Engineering (MSEnvE) is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology. Students seeking this degree must have an engineering undergraduate degree.

a. Special Research Problem Option

EnvE courses (CEE 6310, 6311, 6312)	9
Mathematics	3
Technical concentration electives in EnvE	6
Environmental Sciences & Engineering Lab (CEE 6319)	2
Research presentation (CEE 7310)	1
Technical electives	6
Special Research Problem (CEE 8950)	3
Semester Hours	30*

b. Thesis Option

EnvE courses (CEE 6310, 6311, 6312)	9
Mathematics	3
Technical concentration electives in EnvE	6
Environmental Sciences & Engineering Lab (CEE 6319)	2
Research presentation (CEE 7310)	1
Technical Electives	3
Thesis	6
Semester Hours	30**

Undesignated Master of Science

Students who do not meet the undergraduate degree requirements above but satisfy all the other requirements in their M.S. area of specialization receive the undesignated Master of Science degree.

a. Course option

Required Courses in Major Area of Specialization	18
(Construction Management, Environmental, Geosystems, Structures and Mechanics, Transportation, Water Resources)	
Approved Electives	12
Semester Hours	30*

b. Thesis option

Required Courses in Major Area of Specialization	12
(Construction Management, Environmental, Geosystems, Structures and Mechanics, Transportation, Water Resources)	
Approved Electives	12
Thesis	6
Semester Hours	30**

*21 of the 30 hours of course work must be at the 6000 level or higher.
**12 of the 24 hours of course work must be at the 6000 level or higher.

Students who complete both the bachelor's and any of the above master's degrees in the School of Civil and Environmental Engineering may use up to six credit hours of graduate-level course work (CEE 6000 or higher) in the major discipline for both degrees. In order to qualify for this option, the student must complete the undergraduate degree with a cumulative grade point average of 3.5 or higher and complete the master's degree within two years after the awarding of the bachelor's degree.

Video Based Master's Program
The School of Civil and Environmental Engineering offers working professionals throughout the continental United States the opportunity to enroll in graduate courses in environmental engineering through video technologies. Qualified individuals may complete the requirements for the master's program in environmental engineering utilizing the video-based delivery system.

Doctor of Philosophy

1. Admission to the Ph.D. Program
The Ph.D. program is offered to students with an excellent academic background and a capacity for independent research. Doctoral students tailor a highly individualized program of study directed toward completion of a dissertation that is expected to make an important contribution in their selected area. Doctoral degrees are offered in Civil Engineering and Engineering Science and Mechanics.

After consultation with the appropriate specialty group, the associate chair for Graduate Programs may grant the applicant admission to the Ph.D. program in civil engineering. Applicants must have received an acceptable master's degree or a BSCE or equivalent from an ABET-accredited program of study.

Students currently pursuing a master's degree who wish to continue studies toward the Ph.D. degree must get written approval from the head of the appropriate specialty group. Admission to the Ph.D. program does not constitute admission to candidacy for the Ph.D. degree.

2. Specialty Groups
Applicants are encouraged to pursue inter-disciplinary programs of study and research. For admission to the Ph.D. program, students must select a specialty group from one of the following:

Construction Engineering and Management
Environmental Engineering
Environmental Hydraulics and Water Resources
Geosystems
Structural Engineering, Mechanics, and Materials
Transportation

If the student wishes to change from one specialty to another, the student must obtain written permission from both specialty groups.

3. Requirements for the Degree

a. A program of study must be approved by the student's Guidance Committee and the associate chair of Graduate Studies. There are no fixed course requirements for the Ph.D. degree. The student must have a major and minor field. The minor field is preferably outside the School of Civil and Environmental Engineering and must include at least 9 hours of course work. The minor field must be approved by the Office of Graduate Studies.

b. Pass a Ph.D. comprehensive (qualifying) examination consisting of written and oral portions.

c. Complete a Ph.D. dissertation.

d. Pass the Final Doctoral Examination

Multidisciplinary Certificate Programs

See table on page 122.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

CIVIL ENGINEERING

CEE 1770. Introduction to Engineering Graphics and Visualization
2-3-3. Co-requisite: MATH 1501
Engineering graphics and visualization including sketching, line drawing, simple wire frame, and solid modeling. Development and interpretation of drawings and specifications for product realization. Crosslisted with AE and ME 1770.

CEE 2000. Civil and Environmental Engineering Applications of Probability and Statistics
0-2-1. Prerequisite: MATH 1502; Co-requisite: ISYE 3770.
Applications of probability and statistical inference in civil and environmental engineering problems.

CEE 2010. Computational Modeling in Civil and Environmental Engineering
3-0-3. Prerequisite(s): MATH 1502 and PHYS 2211 and CS 1301.
Fundamentals of numerical methods and development of programming techniques for implementing them to solve civil and environmental engineering problems via computers.

CEE 2020. Statics and Dynamics
3-0-3. Prerequisites: MATH 1502 and PHYS 2211.
Elements of statics in two and three dimensions, centroids, friction, kinematics and kinetics of rigid bodies in plane motion.

CEE 3000. Civil Engineering Systems
3-0-3. Prerequisite: MATH 2401.
Infrastructure viewed from a systems perspective; analytical approaches and modeling of civil-engineered facilities; sustainability; engineering economy applications.

CEE 3010. Geomatics
2-3-3. Prerequisites: CS 1301 and (AE 1770 or CEE 1770 or ME 1770) and MATH 2401.
Spatial data collection methods including surveying, photogrammetry, remote sensing, and global positioning systems; management, manipulation, and analysis of spatial and associated attribute data.

CEE 3020. Civil Engineering Materials
2-3-3. Prerequisite: CEE 2020; Co-requisite: CEE 3030.
Physical, mechanical, and durability properties of concrete, metals, unreinforced and reinforced plastics, timber, asphalt, and asphalt concrete.

CEE 3030. Strength of Materials
3-0-3. Prerequisites: CEE 2020 and MATH 2403; Co-requisite: CEE 3020.
Stress and strain, axially loaded members, torsion of circular sections, bending of beams, transformation of stress and strain, and column buckling.

CEE 3040. Fluid Mechanics
3-0-3. Prerequisite: CEE 2020.
Elementary mechanics of fluids with emphasis on hydrostatics; control volume analysis of flowing fluids using kinematics; continuity, energy, and momentum principles; similitude, pipe flow.

CEE 3050. Structural Analysis
2-3-3. Prerequisites: CEE 3020 and CEE 3030.
Determination of internal forces and deflections in statically determinate trusses, beams, and frames. Introduction to analysis of statically indeterminate structures.

CEE 4100. Construction Engineering and Management
2-3-3.
Fundamental concepts in planning, design, and construction of civil engineering projects. Introduction to project scheduling, cost estimating, controls, procurement, value engineering, quality assurance, and safety.

CEE 4110. Construction Planning, Estimating, and Scheduling
3-0-3.
An integrated approach to planning, estimating, and scheduling of construction projects, including basic and advanced concepts, applications, and tools for developing plans, estimates, and schedules.

CEE 4120. Construction Equipment and Methods
3-0-3.
An integrated approach to construction operations, including basic and advanced concepts, applications, and tools for planning, design, modeling, and analysis of construction operations.

CEE 4200. Hydraulic Engineering
2-3-3. Prerequisites: CEE 3000 and CEE 3040.
Applications of fluid mechanics to engineering and natural systems including fluid drag, open channel flow, turbomachinery, and environmental hydraulics; laboratory experiments; computational hydraulics.

CEE 4210. Hydrology
3-0-3. Prerequisites: CEE 3040 and ME 3322.
Global circulation and the hydrologic cycle, precipitation mechanisms and analysis, evaporation and other losses, streamflow, hydrographs, river and reservoir routing, and frequency analysis.

CEE 4220. Environmental Transport Processes
3-0-3. Prerequisites: CEE 3040
Mixing of pollutants and natural substances in the environment: dynamics of surface and subsurface flows; mixing in rivers, lakes, estuaries, and aquifers; modeling concepts.

CEE 4300. Environmental Engineering Systems
3-0-3. Prerequisites: MATH 2401 and CHEM 1211 and BIOL 1510 and CEE 3000.
Environmental engineering issues associated with water, air, and land pollution including risk assessment, groundwater contamination, global climate change, and sustainable technologies.

CEE 4310. Water Quality Engineering
3-0-3. Prerequisites: BIOL 1510 and CHEM 1211 and CEE 3040 and CEE 4300.
Reclamation of water and wastewater for potable and industrial uses, groundwater remediation. Principles of physical, chemical, and biological treatment processes.

CEE 4320. Hazardous Substance Engineering
3-0-3. Prerequisites: CEE 3040 and CEE 4300.
Technical aspects of hazardous waste management and treatment including legislation, exposure and risk assessment, contaminant fate and transport, waste treatment methods, and remediation technologies.

CEE 4330. Air Pollution Engineering
3-0-3. Prerequisite: CEE 4300.
Introduction to the physical and chemical processes affecting the dynamics and fate of air pollutants at the local, regional, and global scales. Particular emphasis is on tropospheric pollutant chemistry and transport.

CEE 4390. Environmental Engineering/Water Resources Design
2-3-3. Prerequisites: CEE 4200 and CEE 4210 and CEE 4310.
Interdisciplinary design course in environmental engineering and water resources including process design, hydraulic design, reservoir operations and analysis, cost estimates, plans and specifications.

CEE 4400. Geosystems Engineering
3-0-3. Prerequisites: EAS 2601 and CEE 3000 and CEE 3030.
Introduction to engineering behavior of soils; mechanical, chemical, electrical, and thermal properties; continuum design principles including theory of elasticity and limiting equilibrium applied to particulate soils.

CEE 4410. Geosystems Engineering Design
3-0-3. Prerequisite: CEE 4400.
Analysis and design in geosystems engineering projects, including the evaluation of pile foundations, slope stability, earth retaining structures, and embankments.

CEE 4420. Subsurface Characterization
2-3-3. Prerequisite: CEE 4400.
Introduction to field and laboratory methods for characterizing subsurface geological, hydrological, geotechnical, and contaminant conditions.

CEE 4430. Environmental Geotechnics
3-0-3. Co-requisite: CEE 4400.
Chemical equilibria and partitioning in subsurface systems; hazardous waste site assessment technologies and data; including soil gas data, monitoring wells, and direct-push technology.

CEE 4510. Structural Steel Design
3-0-3. Prerequisites: CEE 3020 and CEE 3050.
Principles of behavior of tension and compression members, beams, and connections with application to the design of elementary structures.

CEE 4520. Reinforced Concrete Design
3-0-3. Prerequisites: CEE 3020 and CEE 3050 and CEE 4400.
Principles of behavior of reinforced concrete beams, short columns, and slabs, with application to the design of elementary concrete structures, foundation, and earth retaining structures.

CEE 4530. Timber and Masonry Design
3-0-3. Prerequisite: CEE 4520.
Stress-based design of tension, compression, and flexural members; design of building systems, unreinforced and reinforced walls using timber and masonry construction materials and techniques.

CEE 4540. Infrastructure Rehabilitation
2-3-3. Prerequisites: CEE 3000 and CEE 3030 and CEE 4100.
Rehabilitation of civil infrastructure systems including aspects of deterioration science, nondestructive assessment, renewal engineering, construction planning and management, and public policy and finance.

CEE 4550. Structural Analysis II
3-0-3. Prerequisite: CEE 3050.
Analysis of two- and three-dimensional statically indeterminate structures by classical and matrix methods of solution. Flexibility and stiffness techniques, influence lines, approximate analysis, and nonlinear analysis.

CEE 4600. Transportation Planning, Operations, and Design
2-3-3. Prerequisites: MATH 2401 and CEE 2010 and CEE 3000
Introduction to transportation engineering with specific emphasis on the planning, design, and operation of transportation facilities.

CEE 4610. Multimodal Transportation Planning, Design, and Operations
3-0-3. Prerequisite: CEE 4600.
Planning, design, and operation of systems of air, rail, water, and highway facilities, including those for bicycles and pedestrians.

CEE 4620. Environmental Impact Assessment
3-0-3.
Key policy, planning, and methodological issues in the environmental impact assessment of engineering systems including the regulatory framework and analytical techniques.

CEE 4630. Computer-Aided Site and Roadway Design
2-3-3. Prerequisites: CEE 4600 and (AE 1770 or CEE 1770 or ME 1770).
Site development principles and application to a comprehensive design project using computer-based digital terrain model software tools.

CEE 4791. Mechanical Behavior of Composites
3-0-3. Prerequisite: ME 3311.
Stress-strain behavior of composites, property of matrix and reinforcing materials, mechanics of fiber-reinforced composites, lamina and laminate analysis, and mechanical performance. Crosslisted with AE, CHE, ME, MSE, and TFE 4791.

CEE 4793. Composite Materials and Processes
3-0-3. Prerequisites: CHEM 1211 and PHYS 2212.
Basic principles of selection and design of composite materials and their manufacturing and testing. Cost factors. Laboratory exercises on manufacturing and tests. Crosslisted with AE, ME, MSE, and CHE 4793.

CEE 4794. Composite Materials and Manufacturing
2-3-3. Prerequisites: CHEM 1211 and PHYS 2212.
Basic principles of selection and sign of composite materials and their manufacturing and testing. Cost factors. Laboratory exercises on manufacturing and tests. Crosslisted with AE, CHE, ME, MSE, and TFE 4794.

CEE 4801,-2,-3,-4,-5,-6. Special Topics
Credit hours equal last digit of course number.

CEE 4900. Undergraduate Honors Research Project
Credit hours to be arranged.
Individual research projects conducted in conjunction with and under the direction of a CEE faculty member. Participation by invitation, and agreement with individual faculty members. Project culminates in a thesis and presentation.

CEE 4901,-2,-3. Special Problems
Credit hours to be arranged

CEE 6100. Construction Project Planning
3-0-3.
Introduction to project planning concepts including organization development, computer-based scheduling, computer-based estimating, regulatory agencies, and project financing.

CEE 6110. Computer Applications in Construction
3-0-3.
Introduction to computing tools impacting the construction industry and the analysis techniques used to determine company automation requirements.

CEE 6120. Environmentally Conscious Design and Construction
3-0-3.
Introduction to framework, concepts, principles, strategies, and tools for environmentally conscious design and construction of facilities and civil infrastructure systems.

CEE 6130. Construction Project Controls
3-0-3. Prerequisite: CEE 6100.
Introduction to project control concepts and advanced implementation techniques. Project control concerns including project budgeting, project productivity, cash flow, and resource allocation will be introduced.

CEE 6140. Advanced Planning and Estimating Methods
3-0-3. Prerequisite: CEE 4110.
Overview of advanced methods for planning and estimating construction projects including resource allocation/management, project control techniques, interpretation of schedules and estimates, and value engineering.

CEE 6150. Construction Law
3-0-3.
Overview of construction law and legal issues encountered by the construction engineer and manager.

CEE 6170. Project Delivery and Procurement
3-0-3.
Analysis of construction project delivery including traditional, design-build, construction management, multiple prime contractors, and related financing. The course focuses on the owner's role in construction.

CEE 6180. Construction Organizations
3-0-3.
Introduction to organizational concepts of the construction industry including strategic management, company financing, human resources, and market analysis.

CEE 6190. Construction Field Engineering
3-0-3.
Introduction to construction engineering techniques and practices including site excavation, shoring structures, heavy equipment, site layout, and temporary facility construction.

CEE 6221. Physical Hydrology
3-0-3. Prerequisite: CEE 4210.
Occurrence, movement, and distribution of water. Topics: hydrologic cycle, global circulation, climate, atmospheric water vapor, thermodynamics, precipitation, evaporation, snowmelt, soil moisture, unsaturated flow, infiltration, geomorphology, runoff, and routing.

CEE 6222. Hydrometeorology
3-0-3. Prerequisite: CEE 6221.
Estimation of hydrologic variables from on-site and remote sensors; operational hydrologic models; parameter estimation; operational forecasting.

CEE 6231. Probability and Statistics for Civil and Environmental Engineers
3-0-3.
Probability distributions applicable to civil engineering systems; function of random variables; regression and correlation analysis; parameters estimation and statistical hypothesis tests.

CEE 6232. Stochastic Hydrology
3-0-3. Prerequisite: CEE 6231.
Stochastic modeling of hydrologic processes. Problems of model specifications and parameter identification, and validation. Application to forecasting and synthetic events.

CEE 6241. Water Resources Management I
3-0-3.
Operations research methodologies, including linear and nonlinear programming, and their applications to water resources systems.

CEE 6242. Water Resources Management II
3-0-3. Prerequisite: CEE 6231 and CEE 6241
Design of decision support systems for water resources planning and management.

CEE 6244. Random Fields and Geostatistics
3-0-3.
Probability density function; moments; scales of fluctuations; spectral representation; simulation of random fields; cross-correlated random fields; vector fields; kriging; conditional simulation.

CEE 6251. Intermediate Fluid Mechanics
2-3-3. Prerequisites: CEE 3040 and CEE 4200.
Concepts of linear and angular deformation, vorticity, and conservation of mass. Development of Navier-Stokes with solutions: steady and unsteady uniform laminar, vortex, creeping, and potential flow.

CEE 6252. Advanced Fluid Mechanics
3-0-3. Prerequisite: CEE 6251.
Theory of three-dimensional turbulent boundary layers with application to environmental flows in rivers, estuaries, and the atmosphere of interest in water resources engineering.

CEE 6261. Environmental Fluid Mechanics
3-0-3.
Dynamics, mixing, and contaminant transport in surface water bodies, including lakes, rivers, estuaries, and coastal waters. Introduction to numerical models. Prediction of mixing zones.

CEE 6262. Advanced Environmental Fluid Mechanics
3-0-3. Prerequisite: CEE 6261.
Buoyancy modifications to the mixing and dynamics of pollutant discharges and surface water bodies. Gathering and analysis of laboratory and field data for mixing problems.

CEE 6271. Flow and Transport through Porous Media I
3-0-3. Prerequisite: CEE 6221.
Basic principles governing ground water flow. Topics covered: fundamental principles of saturated and unsaturated ground water flow, contaminant transport, and salt water intrusion.

CEE 6272. Flow and Transport through Porous Media II
3-0-3. Prerequisite: CEE 6271.
Principles of numerical methods used in solving ground water flow, contaminant transport models, building on materials covered in CEE 6271. Topics: finite element, difference methods, saturated, unsaturated ground water flow, and contaminant transport.

CEE 6274. Flow and Transport in Heterogeneous Porous Media
3-0-3. Prerequisite: CEE 6271
Advanced treatment of transport processes in natural porous media: classical description; stochastic description of variability; dynamic models; flow and transport in aquifers; model uncertainty.

CEE 6281. Open Channel Hydraulics
2-3-3. Prerequisite: CEE 4200
Flow of liquids with free surfaces in artificial and natural channels. Analysis of flow resistance. Computation of gradually varied flow profiles. Flow through transitions, spillways, bridges, culverts. Analysis of unsteady flow.

CEE 6282. Sediment Transport
3-0-3. Prerequisite: CEE 4200.
Engineering importance of erosion and sedimentation problems. Topics: properties of non-cohesive/cohesive sediments including specific weight/ gravity/ shape/ size/ size distribution/ fall velocity/ mineral structure/ rheological properties.

CEE 6284. Hydraulic Transients in Fluid Systems
3-0-3. Prerequisites: CEE 3040 and CEE 4200.
Transient flow of liquids in piping systems. One-dimensional wave equations and method of characteristics. Effects of valves and pumps on waterhammer. Cavitation and liquid-column separation.

CEE 6292. Computational Methods for Fluid Dynamics and Hydraulics
3-0-3. Prerequisite: CEE 6271.
Finite-difference, finite-volume methods for partial differential equations; time-marching algorithms for hyperbolic systems; solution of the incompressible Navier-Stokes equations in curvilinear coordinates.

CEE 6293. Hydrodynamic Stability and Turbulence
3-0-3. Prerequisite: CEE 6251.
Flow in stability and turbulence are important in virtually all environmental flows. Fundamental stability, transition and turbulent concepts along with their engineering relevance will be introduced.

CEE 6310. Process Principles in Environmental Engineering
3-0-3.
Principles that can be used in the analysis and modeling of environmental engineering processes, including material and energy balances, mass transfer, and reaction engineering.

CEE 6311. Microbial Principles in Environmental Engineering
3-0-3.
Microbiological principles with emphasis on microbial nutrition and growth, inhibition and control of growth, biochemical thermodynamics, metabolic pathways, enzyme and microbial kinetics.

CEE 6312. Chemical Principles in Environmental Engineering
3-0-3.
Fundamental principles of chemical equilibria and environmental organic chemistry in dilute aqueous systems with emphasis on chemical speciation and environmental engineering applications.

CEE 6313. Fate of Contaminants in the Subsurface
3-0-3. Prerequisite: CEE 6312.
Effects of physical, chemical, and biological processes on the fate and transport of contaminants in unsaturated and saturated porous media.

CEE 6319. Environmental Sciences and Engineering Laboratory
1-3-2. Prerequisites: CEE 6310 and CEE 6311 and CEE 6312.
Laboratory exercises and discussions for the understanding of fundamental chemical analytical, physicochemical, and applied microbiological principles in environmental engineering.

CEE 6330. Physicochemical Processes
3-0-3. Prerequisites: CEE 6310 and CEE 6312.
Theory and application of the physical and chemical processes of coagulation, flocculation, sedimentation, softening, filtration, and disinfection in water and wastewater treatment.

CEE 6331. Biological Processes
3-0-3. Prerequisites: CEE 6310 and CEE 6311 and CEE 6312.
Microbial growth kinetics and bioenergetics, theory, modeling and application of biological processes employed in water, wastewater, and hazardous waste treatment systems as well as subsurface bioremediation.

CEE 6332. Separation Processes
3-0-3. Prerequisites: CEE 6310 and CEE 6312.
Theory and applications of the physical and chemical processes of sorption, membrane separation, and absorption in both gas-phase and liquid-phase environmental engineering systems.

CEE 6333. Hazardous Waste Site Remediation
3-0-3. Prerequisite: CEE 6313
Selection, design, and implementation of hazardous waste site remediation technologies including pump-and-treat, soil vapor extraction, thermal processes, bioremediation, surfactant flushing, and barrier-treatment walls.

CEE 6340. Solid-Liquid Separations
3-0-3. Prerequisites: CEE 6310 and CEE 6311 and CEE 6312.
Characterization, stabilization, conditioning, thickening, dewatering, conversion, recovery, transportation, and disposal of air, water, and wastewater treatment residues.

CEE 6341. Industrial Waste Treatment and Disposal
2-3-3.
A review of current policies and approaches in industrial waste treatment, and application of engineering principles and processes for waste treatment, recovery, and disposal.

CEE 6342. Solid Waste Technology
2-3-3.
An introduction of the current regulations and fundamentals of solid waste management, characterization, handling, recycling, transportation, and final disposal systems.

CEE 6343. Membrane Processes
3-0-3. Prerequisites: CEE 6310 and CEE 6312.
An introduction of the theories of membrane separation processes with special emphasis on desalination, softening, THM precurors reduction using reverse osmosis and nanofiltration.

CEE 6350. Advanced Environmental Chemistry
3-0-3. Prerequisite: CEE 6312.
Chemical behavior of inorganic and organic compounds in natural waters. Topics include chemistry of metal ions, partitioning and distribution of organic pollutants, surface reactions.

CEE 6351. Biotransformation of Xenobiotic Compounds
3-0-3. Prerequisite: CEE 6311.
Biotransformation pathways and kinetics of anthropogenic recalcitrant compounds and biological, biochemical, and environmental factors affecting these transformations in natural and engineered systems.

CEE 6355. Industrial Ecology in Environmental Engineering
3-0-3.
Introduces the principles of environmentally conscious products, processes, and manufacturing systems.

CEE 6360. Design of Treatment Facilities for Drinking Water
2-3-3. Prerequisite: CEE 6330.
Theory and design of process tanks and equipment for capture, purification, conditioning, storage, and distribution of safe drinking water.

CEE 6361. Modeling and Simulation of Biological Treatment Systems
2-3-3. Prerequisite: CEE 6331.
Theory and design of biological treatment systems for water reclamation; nutrient removal; and integrated process design and optimization using advanced computer models.

CEE 6390. Air Pollutant Formation and Control
3-0-3.
Analysis of air pollutants through the study of radical reaction pathways, combustion processes, and removal of particles and gaseous pollutants from exhaust gas streams.

CEE 6391. Advanced Topics in Air Pollution
1-0-1.
Current topics in air pollution engineering presented and discussed.

CEE 6402. Soil Mechanics
3-0-3. Prerequisite: CEE 4400.
Fundamental concepts related to the mechanical behavior of soils, including: effective stress, strength, stiffness, permeability, time-dependent behavior.

CEE 6403. Environmental Geotechnics
3-0-3. Prerequisite: CEE 4400.
Evaluation of equilibria and partitioning as applied to site assessment techniques including soil gas data, monitoring wells, soil samples, and direct-push technology.

CEE 6421. Laboratory Characterization of Geomaterials
2-3-3. Prerequisite: CEE 4400.
Instruction in the procedures, methods of interpretation, and apparatus limitations and influences for geotechnical laboratory index, strength, deformation, and permeability tests.

CEE 6422. Experimental Methods in Soil Behavior
2-3-3.
Macrobehavior and microlevel phenomena in particulate media are experimentally studied. Topics in experimental research include: scale effects, similarity, falsification, errors, transducers, design of experiments.

CEE 6423. In-Situ Testing and Site Characterization of Geomaterials
3-0-3.
Field testing and sampling of geomaterials, primarily soils and rocks. Introduces methods of drilling, probing, and in-situ measurement of soils for determining stratigraphy and engineering parameters for analysis, including soil borings, cone penetration, pressuremeter, dilatometer, and other tests.

CEE 6424. Engineering Geophysics
2-3-3. Prerequisite: CEE 6442.
Geophysical techniques used to characterize near-surface soils and rocks including seismic, magnetic, electromagnetic, radar, and resistivity methods.

CEE 6441. Analysis of Earth Structures
3-0-3. Prerequisite: CEE 6402.
Instruction in techniques for assessing the stability of earth-retaining structures including unreinforced slopes, reinforced slopes, free-standing retaining structures, and reinforced retaining structures.

CEE 6442. Dynamic Analysis in Geotechnical Engineering
3-0-3. Prerequisite: CEE 6402.
Dynamic soil properties; response of foundations to dynamic loads; construction and blast vibration criteria; dynamic analysis of pile driving; introduction to liquefaction potential.

CEE 6443. Foundation Systems
3-0-3.
Evaluation and design of foundations for civil engineering structures, including the settlement and bearing capacity of shallow spread footings, mats, and deep foundations.
Footings, driven piles, bored piles, and drilled shafts analyzed using elastic continuum theory, limit plasticity, and cavity expansion solutions, supplemented with numerous case studies. Ancillary topics include axial load transfer, pile group interaction, lateral and moment loading, and pile dynamics.

CEE 6444. Geosynthetics in Civil Engineering
3-0-3. Prerequisites: CEE 3020 and CEE 4400.
Development, fabrication, design, and applications of geotextiles, geogrids, geonets, and geomembranes.

CEE 6445. Geotechnical Earthquake Engineering
3-0-3.
Earthquake magnitude and intensity, seismic hazard evaluation using deterministic and probabilistic approaches, site response analyses and ground motion amplification liquefaction, and response of earth structures.

CEE 6446. Geotechnical Seepage Analysis
3-0-3. Prerequisite: CEE 6402.
Seepage and its effects on engineering behavior of soils and its consequences for design of geo-infrastructure.

CEE 6447. Ground Modification
3-0-3. Prerequisite: CEE 6402.
Methods for improving marginal construction sites for geotechnical engineering projects and rehabilitation of geo-infrastructure.

CEE 6448. Landfill Design and Management
3-0-3. Prerequisite: CEE 6402.
The course deals with geo-material selection and characterization, chemical compatibility, placement procedures (including compaction), design strategies, seepage issues, instrumentation, and environmental monitoring.

CEE 6449. Design of Remediation Systems
3-0-3. Prerequisite: CEE 6403.
Design of remediation systems and management approaches for the petrochemical, power generation, metals finishing, and mining industries are emphasized. Risk analysis and case histories are presented.

CEE 6450. Pavement Design
3-0-3. Prerequisite: CEE 4400.
Analysis and design of flexible and rigid pavement for highway and airfield runway, evaluation of pavement performance and distress, and pavement rehabilitation strategy and techniques.

CEE 6451. Rock Mechanics
3-0-3. Prerequisites: CEE 6751 or EAS 6751.
Rock characterization, scale effect, in-situ stresses, mechanisms of rock deformation and fracture, rock engineering; special attention to common principles unifying presented set of topics.

CEE 6461. Mathematical Applications for Civil and Environmental Engineering
3-0-3.
Mathematical techniques are reviewed in the context of CEE problems. The simplified yet mathematically rigorous approach highlights the internal mathematical connections between different engineering problems.

CEE 6462. Signals and Inverse Problems in Civil Engineering
3-0-3. Prerequisite: CEE 6402.
Civil engineering signals and systems. Discrete time and frequency domain operations. Nonlinear and nonstationary systems. Inverse problems. Matrix-based and other solutions. Tomography. Civil engineering examples.

CEE 6463. Constitutive Modeling of Soils
3-0-3. Prerequisite: CEE 6402
Fundamental concepts in modeling behavior of soils. Implementation of models into numerical solution codes. Evaluation of models used in practice.

CEE 6481. Unsaturated Soil Mechanics
3-0-3. Prerequisite: CEE 6402.
This course presents many of the fundamental concepts behind the mechanical behavior of unsaturated soils.

CEE 6482. Applied Fracture Mechanics
3-0-3. Prerequisite: CEE 6451
Application of fracture mechanics toward practical problems. General fracture behavior studied in the context of a variety of applied topics. Computer and experimental demonstrations.

CEE 6483. Geotechnical Image and Spatial Analysis
3-0-3. Prerequisite: CEE 6402.
Presentation of techniques for spatial and image processing and analysis of subsurface data at micro and macro scales.

CEE 6484. Industrial Byproduct Reutilization
2-3-3. Prerequisite: CEE 6402.
The objective of this course is to explore more fully the interface between geotechnology, geochemistry, and sustainable engineering to develop new applications using industrial byproducts.

CEE 6485. Wave-based Characterization of Particulate Materials
3-0-3. Prerequisite: CEE 6402.
Characterization of materials with mechanical and electromagnetic waves. Emphasis on particulates with extensions to other materials. Laboratory and field applications.

CEE 6501. Matrix Structural Analysis
3-0-3. Prerequisite: CEE 4500.
Static analysis of framed structures by flexibility and stiffness methods; computer models and solutions for applied loads, temperature, support settlement, and member prestrain effects.

CEE 6504. Finite Element Method of Structural Analysis
3-0-3. Prerequisite: CEE 6551.
Introduction to the element method with emphasis on analysis of solids and structures. One-, two-, and three-dimensional finite. Modeling, approximations, and errors.

CEE 6507. Nonlinear Finite Element Analysis
3-0-3. Prerequisite: CEE 6504
Lagrangian formulations for nonlinear analysis of solids and structures, including consistent linearization and state determination. Incremental-iterative solution approaches; computational plasticity. Software implementation.

CEE 6510. Structural Dynamics
4-0-4. Prerequisite: CEE 6501.
Vibration and dynamic response of linear and nonlinear structures to periodic and general disturbing forces, with and without damping effects. Wind and earthquake SDOF and MDOF effects.

CEE 6513. Computational Methods in Mechanics
3-0-3.
Generalization of finite element concepts; Galerkin-weighted residual and variational approaches; mixed and hybrid finite element formulations, applications, transient dynamic analysis; software implementation.

CEE 6521. Reinforced Concrete Members
3-0-3. Prerequisite: CEE 4520.
Behavior and design of RC members; ductility and inelastic response; deep beams; corbel and torsion design; column biaxial bending; shearwalls; effects of creep and shrinkage.

CEE 6522. Reinforced Concrete Slab Systems
3-0-3. Prerequisite: CEE 6521.
Analysis and design of two-way slab systems, structural walls, and complex building configurations. Equivalent frame and analysis, strip and yield-line technique, application of finite element method to design of slab and wall systems.

CEE 6523. Prestressed Concrete
3-0-3. Prerequisite: CEE 4520.
Principles and practice of prestressed concrete. Analysis and design of statically determinate and indeterminate beams, and one-way and two-way slabs; precast pre-tensioned, post-tensioned.

CEE 6527. Advanced Structural Steel Design
3-0-3.
Strength, behavior, and design of steel structures according to WSD and LRFD. Plate girders, composite beams, bolted and welded connections, beam-columns, and torsion.

CEE 6530. Structural Systems
3-0-3. Prerequisites: CEE 4550 and CEE 6522 and CEE 6523 and CEE 6527.
Behavior and design of steel and concrete building and bridge systems. Introduction to structural planning with emphasis on economics, structural behavior, serviceability, and strength considerations.

CEE 6533. Design of Polymer Composite Structures
3-0-3. Prerequisites: AE 4791 or CEE 4791 or CHE 4791 or ME 4791 or MSE 4791 or TFE 4791.
.Strength, behavior, and design of polymeric composites, structural members, and connections for civil engineering applications.

CEE 6536. Rehabilitation of Existing Structures
3-0-3.
Deterioration science; corrosion of steel, alkali-silica reaction, freezing and thawing. Assessment and evaluation of existing structures, non-estructive testing, and nondestructive evaluation.

CEE 6541. Earthquake Engineering
3-0-3. Prerequisite: CEE 6510.
Characteristics of earthquakes; design and rehabilitation of civil engineering structures for earthquake ground motion; code provisions; case studies.

CEE 6544. Structural Modeling
3-0-3.
Modeling of structures for static, dynamic, and nonlinear analysis using finite elements. Effects of parameters on the structural behavior.

CEE 6547. Nonlinear Design of Frame Structures
3-0-3. Prerequisite: CEE 6527.
Analysis and design of structures based on ultimate load capacity. Application of the fundamental theorems of plastic design to continuous beams, frames, and grillages.

CEE 6551. Advanced Strength of Materials
3-0-3.
Study of advanced topics from mechanics of materials with application to structures. Typical topics: energy methods, failure theories, post-yield behavior, generalized bending, and torsion.

CEE 6554. Theory of Elastic Stability
3-0-3.
Concepts of elastic stability, simple mechanical models, buckling of beam-columns and frames, beams on elastic foundation, and plates energy methods, torsional and lateral buckling.

CEE 6557. Theory of Plates and Shells
3-0-3.
Plate bending, approximate methods, nonlinearity, stiffened and anisotropic plates. Stress and deformation of shells with and without bending, surfaces of revolutions, and shallow shells.

CEE 6560. Applied Elasticity
3-0-3.
Introduction to traction, stress, and equilibrium; deformations, strain compatibility; constitutive equations; two-dimensional problems in Cartesian and polar coordinates; application to extension, bending, and torsion.

CEE 6563. Energy Methods in Mechanics
3-0-3.
Virtual work, principles of potential energy and complementary energy, Castigliano's theorems, generalized and stationary variational principles, energy methods, structural applications, nonlinear problems, Hamilton's principle.

CEE 6566. Plasticity and Viscoelasticity
3-0-3. Prerequisites: CEE 6581 or CEE 6572.
Plastic deformation, yield conditions, flow rules and normality, relaxation and creep, viscoelasticity, tubes and spheres, torsion and bending, slip line fields, viscoelastic boundary value problems.

CEE 6569. Wave Propagation in Solids
3-0-3. Prerequisite: CEE 6560.
Plane waves in elastic half-spaces, reflection and refraction; Rayleigh and Stonely waves; waveguides, Love waves, Rayleigh-Lamb modes; Cagniard-de Hoop method; in anisotropic media.

CEE 6571. Experimental Stress Analysis
2-3-3.
Study of surface stress and strain using brittle coatings and strain gauges. Strain gauge circuits, static and dynamic problems, transducer design and circuits.

CEE 6581. Engineering Programming Methods
2-3-3.
Engineering programming concepts through the application of numerical solution techniques including program development, efficiencies, documentation, and testing using formal data structures and algorithms.

CEE 6582. Knowledge-Based Programming Methods in Engineering
2-3-3. Prerequisite: CEE 6581.
The usage and development of knowledge-based computer systems in engineering is studied. Topics include knowledge acquisition, representation, and verification.

CEE 6583. Object-Oriented and Multimedia Programming in Engineering
3-0-3. Prerequisite: CEE 6581
Coverage of object-oriented and multimedia technologies is presented for their proper development and utilization in solving engineering problems.

CEE 6601. Linear Statistical Models in Transportation
3-3-4. Prerequisite: CEE 3001.
Theory of simple and multivariate regression and analysis of variance models. Assessment of modeling assumptions and remedial measures. Applications in the field of transportation planning.

CEE 6602. Urban Transportation Planning
3-3-4.
An overview course on the history, finance, operations, modeling, politics, environmental impacts, and planning of urban transportation systems in the United States.

CEE 6603. Traffic Engineering
2-3-3. Prerequisite: CEE 4601.
Characteristics of traffic demand, traffic flow, vehicles, drivers, roadways, and pedestrians. Studies and data analysis. Capacity analysis. Traffic control and intelligent systems. Operations and management.

CEE 6604. Geometric Design of Transportation Facilities
2-3-3. Prerequisite: CEE 4601.
Geometric configurations of streets, expressways, busways, railways, and their terminals to meet characteristics of vehicle performance and operator limitations.

CEE 6605. Transportation Administration and Policy Analysis
3-0-3.
Overview of institutions and policy processes in the transportation sector: organizational analysis and implementation; policy analysis.

CEE 6621. GIS in Transportation
2-3-3.
Theory and application of GIS applied to transportation engineering and planning (GIS-T). Laboratory focuses on GIS-T development.

CEE 6622. Travel Demand Analysis
2-3-3. Prerequisite: CEE 6602.
Examination of methods for forecasting future site and regional-level travel demand. Model specification, calibration, and validation.

CEE 6623. Survey Design and Analysis
3-0-3. Prerequisite: CEE 6601.
Design of telephone, mail out, and personal interview survey instruments. Subsequent estimation of choice-based models from cross-sectional and panel survey data.

CEE 6624. Land Use-Transportation Interaction
3-0-3. Prerequisite: CP 6311
Overview of land use and transportation planning principles, how development impacts air transportation, how transportation investments impact development patterns and air quality.

CEE 6625. Transportation, Energy, and Air Quality
3-0-3. Prerequisite: CEE 4008.
Students investigate relationships between transportation demand, energy supply and consumption, fuel types, greenhouse gas emissions, and relationships between vehicle technology, pollutant emissions, modeling techniques, and air quality.

CEE 6631. Signalized Intersections and Networks
2-3-3. Prerequisite: CEE 6603.
Traffic-responsive signalization. Detector placement and signal timing at individual intersections. Hands-on practice with equipment. Timing of coordinated systems. Signal plans and specifications.

CEE 6632. Simulation Models in Transportation
2-3-3. Prerequisite: CEE 6603.
Simulation models in transportation: development, calibration, applications, and analysis of outputs.

CEE 6633. Advanced Traffic Detection and Control
3-0-3. Prerequisites: CEE 6603 and CEE 6631.
Latest developments in traffic control equipment and software, including incident management. Communications-technology alternatives. Video, other above-road detector technologies. Hands-on practice with equipment.

CEE 6634. Transportation Safety Analysis
3-0-3. Prerequisite: CEE 6601.
Understanding the human factors elements of transportation safety, and how to appropriately model the highly complex and stochastic occurrence of accidents on a transportation network.

CEE 6635. Technology Innovation in Transportation
3-0-3.
Technology innovations in transportation including Intelligent Transportation Systems. Planning and design of ITS systems.

CEE 6636. Traffic Flow Theory
2-3-3. Prerequisite: CEE 6603.
Advanced study of underlying principles and analytical procedures used in performing capacity analyses of transportation facilities. Highway Capacity Manual procedures and other analytical techniques presented.

CEE 6641. Transportation Infrastructure Management and Traffic Control
3-0-3. Prerequisites: CEE 6603 and CEE 6604.
Transportation infrastructure traffic control and safety-related issues are addressed for initial implementation of transportation facilities as well as daily operational aspects.

CEE 6642. Transit Systems Planning and Design
3-0-3.
Introduction to transit system planning and design concepts. Course will discuss the planning, design, and operations of transit systems, and the operations of intermodal terminals.

CEE 6644. Airport Planning and Design
2-3-3 Prerequisite: CEE 4601
Airport site selection, runway length and orientation, traffic control, drainage and lighting, long-range planning, government responsibility for air transportation.

CEE 6751. Physical Properties and Rheology of Rocks
2-3-3
Structure, properties, and rheology of minerals and rocks with applications to engineering structures and natural phenomena in the earth. Fundamentals of rock mechanics and crack propagation. Crosslisted with EAS 6751.

CEE 6761. Contaminated Sediment Geochemistry
3-0-3. Prerequisite: CEE 6312.
Acquaints students with fate of major pollutants, nutrients, organic compounds, such as pesticides, PAHs, and trace metals in sedimentary systems. Crosslisted with EAS 6761

CEE 6790. Air Pollution Physics and Chemistry
3-0-3.
Introduction to physical and chemical processes affecting dynamics and fate of air pollutants at local, regional, and global scales; emphasis on tropospheric pollutant chemistry and transport. Crosslisted with EAS 6790.

CEE 6792. Air Pollution Meteorology and Chemistry
3-0-3.
Vertical temperature and wind structure, topographic effects, natural removal processes, atmospheric dispersion of stack effluents, air pollution climatology, meteorological management of air pollution. Crosslisted with EAS 6792.

CEE 6793. Atmospheric Boundary Layer
3-0-3.
Structure and dynamics of atmospheric boundary layer. Introduction to turbulence and turbulent transport. Crosslisted with EAS 6793.

CEE 6794. Atmospheric Chemical Modeling
3-0-3.
Prerequisites: EAS 6410 or (EAS 6790 or CEE 6790).
Application of modern numerical methods to the prediction of atmospheric chemical and physical compositions; specific applications using computer models developed by students are included. Crosslisted with EAS 6794.

CEE 6795. Atmospheric Aerosols
3-0-3. Prerequisite(s): EAS 6410 or EAS 6790 or CEE 6790.
Chemical and physical properties of natural and anthropogenic aerosols. Sources, transport, transformation, and fate of primary/secondary, organic/inorganic, atmospheric semi-volatiles and aerosols. Crosslisted with EAS 6795.

CEE 7000. Master's Thesis
Credit hours to be arranged.

CEE 7310. Master's Thesis and Research Presentation
1-0-1.
Oral presentation of master's thesis and research projects.

CEE 7772. Fundamentals of Fracture Mechanics
3-0-3. Prerequisites: AE 3201 or MSE 3005.
Advanced study of failure of structural materials under load, mechanics of fracture, and microscopic and macroscopic aspects of the fracture of engineering materials. Crosslisted with AE, CHE, ME, and MSE 7772.

CEE 7773. Advanced Fracture Mechanics
3-0-3. Prerequisites: AE 7772 or CEE 7772 or CHE 7772 or ME 7772 or MSE 7772.
Nonlinear fracture mechanics including elastic-plastic and time-dependent fracture, advanced test methods, J-integral theory, and extensions. Crosslisted with AE, CHE, ME, and MSE 7773.

CEE 7774. Fatigue of Materials and Structures
3-0-3. Prerequisite(s): AE 7772 or CEE 7772 or CHE 7772 or ME 7772 or MSE 7772.
Mechanical and microstructural aspects of nucleation and growth of cracks under cyclic loading conditions, nitch effects, cumulative damage, multiaxial loading, and fatigue crack propagation. Crosslisted with AE, CHE, ME, and MSE 7774.

CEE 7791. Damage, Failure, and Durability of Composite Materials
3-0-3. Prerequisite(s): AE 4791 or CEE 4791 or CHE 4791 or ME 4791 or MSE 4791
Provides knowledge of the fundamental concepts and methods related to analysis and assessment of damage, failure, and durability of composite materials. Crosslisted with AE, CHE, ME, MSE, and TFE 7791.

CEE 7792. Advanced Mechanics of Composites
3-0-3. Prerequisite: CEE 4792.
Anisotropic elasticity, failure theories, hygrothermal behavior, 3-D analysis of laminates, thick laminates, free-edge effects, stress concentrations, joints, creep and fracture of composites. Crosslisted with AE, CHE, ME, MSE, and TFE 7792.

CEE 7793. Manufacturing of Composites
3-0-3. Prerequisites: AE 4793 or CEE 4793 or CHE 4793 or ME 4793 or MSE 4793 or TFE 4793.
Major manufacturing techniques for metal-, ceramic-, and polymer-matrix composites. Modeling of processes with emphasis on fundamental mechanisms and effects. Crosslisted with AE, CHE, ME, MSE, and TFE 7793.

CEE 7999. Doctoral Examination Preparation
Credit hours to be arranged.
For students preparing for the doctoral qualifying examination.

CEE 8091. Construction Seminar
1-0-1.
Introduction to leading-edge industry practices not part of the regular curriculum using field trips and guest lectures.

CEE 8092. Fluid Mechanics and Hydraulics Seminar
1-0-1.
Presentation and discussion of current research developments in water resources by outside speakers, faculty, and gradute students.

CEE 8093. Hydrology and Water Resources Seminar
1-0-1.
Presentation and discussion of current research developments in water resources by outside speakers, faculty, and graduate students.

CEE 8094. Environmental Engineering Seminar
1-0-1.
Developments in environmental engineering science and technology, current practice, current research, and special topics related to environmental quality assessment and control.

CEE 8095. Research Seminar in Environmental Engineering
1-0-1.
Discussion of current research topics in environmental engineering. Presentations by master's and doctoral students.

CEE 8800-1,-2,-3,-4. Special Topics
Credit hours equal the last digit in course number.

CEE 8900,-1,-2,-3. Special Problems
Credit hours to be arranged.

CEE 8950. Master's Special Research Project
Credit hours to be arranged.
Master's research project to be scheduled by MS students not writing thesis.

CEE 8956. Master's Special Research Problem
Credit hours to be arranged.
For non-thesis students performing research.

CEE 8997. Teaching Assistantship
Credit hours to be arranged.
For students holding graduate teaching assistantships.

CEE 8998. Research Assistantship
Credit hours to be arranged.
For students holding a graduate research assistantship.

CEE 8999. Preparation for Doctoral Dissertation
Credit hours to be arranged.
For students in the preliminary stages of formulating their doctoral research program who have not obtained formal approval of dissertation topic.

CEE 9000. Doctoral Thesis
Credit hours to be arranged.

School of Electrical and Computer Engineering

Established in 1896
Principal Location: Van Leer Building
Telephone: (404) 894-2901
E-mail: info@ece.gatech.edu
Website: www.ece.gatech.edu

Chair and Georgia Power Distinguished Professor–Roger P. Webb; *Vice Chair for Faculty Development and Operations and Professor*–J. Alvin Connelly; *Vice Chair for External Affairs and Professor*–Hans B. Püttgen; *Vice Chair for Graduate Affairs and Professor*–David R. Hertling; *Vice Chair for Undergraduate Affairs and Professor*–William E. Sayle; *Vice Chair for Computer Engineering and Program Development and Associate Professor*–Joseph L.A. Hughes; *Assistant to the Chair for Laboratory Instruction*–Thomas E. Brewer; *Assistant to the Chair for Computer Services*–David S. Webb; *Julius Brown Chair and Regents' Professor*–Thomas K. Gaylord; *John O. and Marilu McCarty Chair and Regents' Professor*–Ronald W. Schafer; *Schlumberger Professor in Microelectronics*–Phillip E. Allen; *Weitnauer Chair and GRA Eminent Scholar and Professor*–John A. Copeland; *Duke Power Distinguished Professor*–Ronald G. Harley; *Pippin Chair in Wireless Communications and GRA Eminent Scholar and Professor*–Nikil S. Jayant; *Hightower Chair and Professor*–Edward W. Kamen; *GRA Eminent Scholar Chair and Professor*–John O. Limb; *Joseph M. Pettit Chair in Microelectronics and Professor*–James D. Meindl; *Georgia Power Distinguished Professor and Regents' Professor*–Ajeet Rohatgi; *Pippin Chair in Electromagnetics and Regents' Professor*–Glenn S. Smith; *Joseph M. Pettit Chair in Electronic Packaging and Professor*–Rao R. Tummala; *Byers Eminent Scholar Chair and Professor*–Carl M. Verber; *Regents' Professor*–Russell M. Mersereau; *Regents' Professors Emeriti*–George P. Rodrigue, Kendall L. Su; *Professors*–Ian F. Akyildiz, Thomas P. Barnwell III, Kevin F. Brennan, Mark A. Clements, John F. Dorsey, Robert K. Feeney, Monson H. Hayes III, Richard J. Higgins, William D. Hunt, Richard P. Kenan, W. Marshall Leach Jr., James H. McClellan, Athanasios P. Meliopoulos, John B. Peatman, William T. Rhodes, Jay H. Schlag,

Mark J.T. Smith, Paul G. Steffes, Gordon L. Stüber, John P. Uyemura, George J. Vachtsevanos, Erik I. Verriest, Sudhakar Yalamanchili; *Professors Emeriti*–Cecil O. Alford, Aubrey M. Bush, Daniel C. Fielder, Edward B. Joy, Dale C. Ray, Thomas M. White; *Associate Professors*–Mark G. Allen, John R. Barry, Richard M. Bass, Miroslav M. Begovic, Paul J. Benkeser, Martin A. Brooke, April S. Brown, John A. Buck, W. Russell Callen Jr., Stephen P. DeWeerth, William L. Ditto, Timothy J. Drabik, Ko-Hui Michael Fan, Elias N. Glytsis, Thomas G. Habetler, James O. Hamblen, Bonnie S. Heck, Mary Ann Ingram, Nan Marie Jokerst, David C. Keezer, Arthur J. Koblasz, Joy Laskar, Vijay K. Madisetti, Gary S. May, Mohamed F. Moad, Henry L. Owen, Andrew F. Peterson, Stephen E. Ralph, David E. Schimmel, Waymond R. Scott Jr., Madhavan Swaminathan, David G. Taylor, Yorai Y. Wardi, Douglas B. Williams, D. Scott Wills, Serena M. Zabin; *Assistant Professors*–Abhijit Chatterjee, David R. DeBoer, Paul E. Hasler, Steven W. McLaughlin, Vincent J. Mooney III, Emmanouil M. Tentzeris, Chai-Keong Toh, Linda M. Wills, G. Tong Zhou; *Laboratory Coordinator/Instructor*–Bruce McFarland; *Lecturers*–Anthony J. Ayoub, Kate Cummings-Maloney, Michael D. Furman, Frank C. Lambert, John H. Matthews, W. Whitfield Smith; *Adjunct Faculty*–Bertrand Boussert, Giorgio Casinovi*, Marvin N. Cohen*, Jim D. Echard*, Robert L. Eisner, Anthony Gadient, Allen K. Garrison*, Albin J. Gasiewski, Gary G. Gimmestad*, Nile F. Hartman*, Morris P. Kesler*, Francois Malassenet, John H. Matthews, John G. Meadors*, Romain Murenzi, William R. Owens*, Edward K. Reedy*, Mark A. Richards, Craig Richardson, Bhushan L. Sopori, Christopher Summers, Gisele Welch*, Stephen B. Wicker.
**GTRI*

General Information

The cornerstones of electrical engineering, the control of information and electric power, result from the fact that electrical energy is the only form of energy that can be transmitted efficiently and under controlled conditions, even over great distances, from point of origin to point of use. Utilization of this fact has enabled electrical engineers to pioneer such diverse and important fields as communications, computers, and electric power.

Computer engineering is a relatively new and rapidly growing discipline that encompasses the principles, methods, and tools for the design and implementation of digital systems and the integration of computer technology into a wide range of applications. Rapid advances in underlying technologies have resulted in ever smaller, less costly, and higher-performance computer systems, as well as the use of computers as embedded elements in applications ranging from highly complex communication systems to sophisticated consumer products to common household appliances. The computer engineering program provides a balanced perspective of both hardware and software elements of computing systems, design trade-offs, and applications.

The School of Electrical and Computer Engineering (ECE) provides undergraduate and graduate programs that prepare students to participate in a broad range of career opportunities. Modern facilities and laboratories support experimental and theoretical programs of instruction and research. Additional information about the School is available on the world wide web at **www.ece.gatech.edu/academic** or upon request by calling the School at (404) 894-2900.

Undergraduate Program

The School of Electrical and Computer Engineering offers two undergraduate degree programs: electrical engineering (EE) and computer engineering (CmpE). Both programs include elective hours enabling students to individually tailor their programs to provide emphasis in a particular specialization or exposure to a broad range of subjects.

Elective courses are available in a wide variety of major areas such as analog electronics, bioengineering, computer engineering, systems and control, microelectronics, digital signal processing, optics and photonics, electric power, electromagnetics, and telecommunications. Additionally, students may elect to take advanced courses in other programs such as computer science, physics, or management. Engineering analysis and design concepts are integrated throughout both the electrical engineering and computer engineering programs. Both programs culminate in major design experiences involving a broad range of issues including economics, safety, and societal considerations.

Engineering Entrepreneurship Certificate Program

The School of Electrical and Computer Engineering, in conjunction with the DuPree College of Management, offers an undergraduate certificate program in engineering entrepreneurship. This certificate program provides a strong foundation in management principles and is useful to those engineering students who may consider starting their own businesses during their careers, as well as those considering graduate work in business administration. It should also be attractive to those engineers who wish to broaden their education and understand the business world. Available to EE and CmpE majors, this program requires courses in economics, accounting, finance, marketing, and entrepreneurship. Further information is available upon request to the ECE Academic Office.

Bachelor of Science in Electrical Engineering (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
MATH 1501	CALCULUS I	4
ENGL 1101	ENGLISH COMPOSITION I	3
CHEM 1211	GENERAL CHEMISTRY	4
CS 1301	COMPUTER SCIENCE I	3
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS		16

First Year - Spring Semester

Course Number/Name		*Hours*
MATH 1502	CALCULUS II	4
ENGL 1102	ENGLISH COMPOSITION II	3
PHYS 2211	PHYSICS I	4
CS 1302	COMPUTER SCIENCE II	3
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		17

Second Year - Fall Semester

Course Number/Name		*Hours*
ECE 2025	INTRO. TO SIGNAL PROC.	4
ECE 2030	INTRO. TO COMPUTER ENGR.	3
MATH 2401	CALCULUS III	4
PHYS 2212	PHYSICS II	4
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		18

Second Year - Spring Semester

Course Number/Name		*Hours*
ECE 2031	DIGITAL DESIGN LAB	2
ECE 2040	CIRCUIT ANALYSIS	3
MATH 2403	DIFF. EQUATIONS	4
LAB SCIENCE ELECTIVE	(CHEM, PHYS, BIOL, EAS)	4
ECON 2100	ECONOMICS & POLICY	3
TOTAL SEMESTER HOURS		16

Third Year - Fall Semester

Course Number/Name		*Hours*
ECE 3025	ELECTROMAGNETICS	3
ECE 3040	MICROELECTRONICS CIRC.	4
ECE 3041	INSTRUMENT & CIRC. LAB	2
ISYE/MATH 3770	STATISTICS & APPLICATIONS	3
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		15

Third Year - Spring Semester

Course Number/Name		*Hours*
ECE 3042	MICROELECTRONICS LAB	2
ECE ELECTIVES		9
FREE ELECTIVE		3
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		17

Fourth Year - Fall Semester

Course Number/Name		*Hours*
ECE 4000	PROJ. ENGR. & PROF. PRAC.	3
ECE ELECTIVES		6
ME 3720	THERMO. & FLUID ENGINEERING	3
FREE ELECTIVE		3
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		18

Fourth Year - Spring Semester

Course Number/Name	*Hours*
ECE DESIGN ELECTIVE	3
ECE ELECTIVE	3
ENGINEERING ELECTIVE	3
FREE ELECTIVES	6
TOTAL SEMESTER HOURS	15

TOTAL PROGRAM HOURS = 130 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Electives

The electrical engineering curriculum includes 57 semester hours of electives, subject to the following requirements:

1) Wellness, 2 hours: HPS 1040 or HPS 1061.

2) Humanities, 6 hours: refer to pages 33-34 for a list of approved courses.

3) Social Sciences, 9 hours: must include HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200; refer to pages 33-34 for a list of approved courses to satisfy the remaining hours.

4) Lab Science, 4 hours: BIOL 1510, BIOL 1520, CHEM 1311 + 1312, EAS 1600, EAS 2601, or course(s) approved by the School.

5) Engineering Breadth, 3 hours: 3000 level or above in College of Engineering outside ECE, subject to School approval.

6) ECE, 21 hours: 3000-level or above in ECE, at least 9 hours at the 4000 level or above; must include an approved electrical engineering major design course; must include three of the following course options: ECE 3050, ECE 3055 or 3060, ECE 3065, ECE 3070, ECE 3075, ECE 3080, or ECE 3085.

7) Free (Approved), 12 hours: 3000 level or above in ECE, other engineering, sciences, computing, or management; all other courses subject to School approval.

Additionally, an approved ethics course must be completed; this is normally taken as part of either the humanities or social sciences electives.

Bachelor of Science in Computer Engineering (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
MATH 1501	CALCULUS I	4
ENGL 1101	ENGLISH COMPOSITION I	3
CHEM 1211	GENERAL CHEMISTRY	4
CS 1301	COMPUTER SCIENCE I	3
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS		16

First Year - Spring Semester

Course Number/Name		*Hours*
MATH 1502	CALCULUS II	4
ENGL 1102	ENGLISH COMPOSITION II	3
PHYS 2211	PHYSICS I	4
CS 1302	COMPUTER SCIENCE II	3
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		17

Second Year - Fall Semester

Course Number/Name		*Hours*
ECE 2025	INTRO. TO SIGNAL PROC.	4
ECE 2030	INTRO. TO COMPUTER ENGR.	3
MATH 2401	CALCULUS III	4
PHYS 2212	PHYSICS II	4
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		18

Second Year - Spring Semester

Course Number/Name		*Hours*
ECE 2031	DIGITAL DESIGN LAB	2
ECE 2040	CIRCUIT ANALYSIS	3
MATH 2403	DIFF. EQUATIONS	4
LAB SCIENCE ELECTIVE (CHEM, PHYS, BIOL, EAS)		4
ECON 2100	ECONOMICS & POLICY	3
TOTAL SEMESTER HOURS		16

Third Year - Fall Semester

Course Number/Name		*Hours*
ECE 3040	MICROELECTRONIC CIRC.	4
ECE 3041	INSTRUMENT & CIRC. LAB	2
ECE 3055	COMPUTER ARCH. & OP. SYS.	4
MATH 2602	LINEAR & DISCRETE MATH.	4/3
or		
MATH 3012	APPL. COMBINATORICS	
CS 2330	LANGUAGES & TRANSLATION	3
TOTAL SEMESTER HOURS		17/16

Third Year - Spring Semester

Course Number/Name		*Hours*
ECE 3042	MICROELECTRONICS LAB	2
ECE 3060	VLSI & ADV. DIG. DESIGN	4
ECE 3025	ELECTROMAGNETICS	3
SOCIAL SCIENCE ELECTIVE		3
ISYE/MATH 3770	STATISTICS & APPLICATIONS	3
TOTAL SEMESTER HOURS		15

Fourth Year - Fall Semester

Course Number/Name		*Hours*
ECE 4000	PROJ. ENGR. & PROF. PRAC.	3
ECE/CS ELECTIVES		4
ME 3720	THERMO. & FLUID ENG'R.	3
FREE ELECTIVE		3
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		16

Fourth Year - Spring Semester

Course Number/Name	*Hours*
COMPUTER ENGR. DESIGN ELECTIVE	4
ECE/CS ELECTIVES	7/8
SOCIAL SCIENCE ELECTIVE	3
FREE ELECTIVE	3
TOTAL SEMESTER HOURS	17/18

TOTAL PROGRAM HOURS = 130 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Electives

The computer engineering curriculum includes 46 semester hours of electives, subject to the following requirements:

1) Wellness, 2 hours: HPS 1040 or HPS 1061.

2) Humanities, 6 hours: refer to pages 33-34 for a list of approved courses.

3) Social Sciences, 9 hours: must include HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200; refer to pages 33-34 for a list of approved courses to satisfy the remaining hours.

4) Lab Science, 4 hours: BIOL 1510, BIOL 1520, CHEM 1311 + 1312, EAS 1600, EAS 2601, or course(s) approved by the School.

5) Math: MATH 2602 (4 hours) or MATH 3012 (3 hours); course must be taken on a letter-grade basis.

6) ECE/CS, 15 hours (Math 2602 taken) or 16 hours (Math 3012 taken): 3000 level or above in ECE or CS, at least 9 hours at the 4000 level or above; must include an approved computer engineering major design course.

7) Free (Approved), 6 hours: 3000 level or above in ECE, other engineering, sciences, or management; all other courses subject to School approval.

Additionally, an approved ethics course must be completed; this is normally taken as part of either the humanities or social science electives.

Graduate Programs

Programs leading to the master's and doctoral degrees in electrical and computer engineering are provided by the School. Technical interest areas include bioengineering, computer engineering, digital signal processing, electric power, electromagnetics, electronic design and applications, microelectronics, optics and photonics, systems and controls, and telecommunications.

The master's degree program requires 30 semester-credit hours beyond the bachelor's degree. Courses are offered all three terms, making it possible for part-time students to continue an uninterrupted program of study throughout the year. Full-time students can complete the master's program in one calendar year.

The doctoral degree program is research-oriented and highly individualized. Typically, at least four years of study beyond the bachelor's degree are required to complete the doctoral program.

Georgia Tech Lorraine

Students may choose to pursue graduate degrees in electrical and computer engineering at Georgia Tech Lorraine, the European platform of the Georgia Institute of Technology, located in Metz, France. In addition to courses taught in English by regular Georgia Tech faculty, students also may participate in courses and academic programs offered by partner French universities. For further information, see page 20.

Video-Based Master's Program

The School of Electrical and Computer Engineering offers working professionals throughout the continental United States the opportunity to enroll in many of its graduate courses through video technologies. Qualified individuals can complete the requirements for the master's degree utilizing the video-based delivery system. See page 36, Video-Based Instruction.

Master of Science and Ph.D. in Bioengineering

The School of Electrical and Computer Engineering is one of the participating schools in the interdisciplinary program leading to a Master of Science and Ph.D. in Bioengineering. The program curriculum was developed by a broadly based faculty group with research activities in bioengineering and the life sciences. The students in the program are enrolled in a participating school, such as ECE, as their home department. The master's degree is complementary to the one offered to graduate students in electrical and computer engineering. For more details on the degree requirements for both the M.S. and Ph.D. in Bioengineering, see page 132.

Multidisciplinary Programs

See table on page 122.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

Note: Detailed topical course outlines are provided on the world wide web at ***www.ece.gatech.edu/academic/***

ELECTRICAL AND COMPUTER ENGINEERING

ECE 1750. Introduction to Bioengineering
3-0-3.
An introduction to the field of bioengineering, including the application of engineering principles and methods to problems in biology and medicine, the integration of engineering with biology, and the emerging industrial opportunities. Crosslisted with AE, CHE, ME, and MSE 1750.

ECE 1801,-2,-3,-4,-5. Special Topics
Credit hours equal last digit in course number

ECE 1811,-2,-3,-4,-5. Special Topics
Credit hours equal last digit in course number.

ECE 1881,-2,-3,-4. Special Topics
Credit hours equal last digit in course number.

ECE 1891,-2,-3,-4. Special Topics
Credit hours equal last digit in course number.

ECE 1900,-1,-2,-3. Special Problems
Credit hours to be arranged

ECE 2001,-2,-3. ECE Seminar
1-0-1, each.
Speakers with diverse backgrounds and representing many different industries, professions, and institutions describe their experiences, entrepreneurial ventures, and research challenges.

ECE 2025. Introduction to Signal Processing
3-3-4. Prerequisites: MATH 1502 and CS 1301
Introduction to signal processing for discrete-time and continuous-time signals. Filtering. Frequency response. Fourier Transform. Z Transform. Laboratory emphasizes computer-based signal processing.

ECE 2030. Introduction to Computer Engineering
3-0-3. Prerequisite: CS 1301
Computer system and digital design principles. Architectural concepts, software, Boolean algebra, number systems, combinational datapath elements, sequential logic, and storage elements. Design of DRAM control and I/O bus.

ECE 2031. Digital Design Laboratory
1-3-2. Prerequisite: ECE 2030
Design and implementation of digital systems, including a team design project. CAD tools, project design methodologies, logic synthesis, and assembly language programming.

ECE 2040. Circuit Analysis
3-0-3. Prerequisites: ECE 2025 and PHYS 2212; Co-requisite: MATH 2403.
Basic concepts of DC and AC circuit theory and analysis.

ECE 2801,-2,-3,-4,-5. Special Topics
Credit hours equal last digit in course number.

ECE 2811,-2,-3,-4,-5. Special Topics
Credit hours equal last digit in course number.

ECE 2881,-2,-3,-4. Special Topics
Credit hours equal last digit in course number.

ECE 2891,-2,-3,-4. Special Topics
Credit hours equal last digit in course number.

ECE 2900,-1,-2,-3. Special Problems
Credit hours to be arranged.

ECE 3025. Electromagnetics
3-0-3. Prerequisites: ECE 2040 and MATH 2403.
Presents the laws and applications of electromagnetics.

ECE 3040. Microelectronic Circuits
3-0-3. Prerequisites: ECE 2030 and ECE 2040 and MATH 2403 and CHEM 1211.
Basic concepts of microelectronic materials, devices, and circuits.

ECE 3041. Instrumentation and Circuits Laboratory
1-3-2. Prerequisite: ECE 2031; Co-requisite: ECE 3040.
Elementary circuits. Basic concepts of laboratory practice and instruments. The course serves as a basis for subsequent laboratory instruction.

ECE 3042. Microelectronic Circuits Laboratory
1-3-2. Prerequisites: ECE 3040 and ECE 3041.
Design, analysis, simulation, implementation, and evaluation of electronic circuits. Employs discrete diodes, bipolar junction, metal oxide semiconductior and field effect transistors, and some integrated circuits.

ECE 3050. Analog Electronics
3-0-3. Prerequisite: ECE 3040.
Presents concepts of analysis and design of electronic circuits and systems. Biasing, small-signal analysis, frequency response, feedback amplifiers, active filters, nonlinear op-amp applications, and oscillators.

ECE 3055. Computer Architecture and Operating Systems
3-3-4. Prerequisites: ECE 2031 and CS 1302.
Core concepts of computer architecture and operating systems. Instruction set architectures (ISA), compiler/ISA relationships, pipelined datapaths. Memory hierarchy, memory management, and protection. Processes, threads, CPU scheduling, and associated techniques.

ECE 3060. VLSI and Advanced Digital Design
3-3-4. Prerequisites: ECE 2031 and ECE 3040.
Advanced digital design issues in the context of VLSI systems. Introduction to a design methodology that encompasses the range from behavioral models to circuit simulation.

ECE 3065. Electromagnetic Applications
3-0-3. Prerequisite: ECE 3025.
Presents concepts in waveguiding and radiation, with application to microwaves, antennas, and optics.

ECE 3070. Electromechanical and Electromagnetic Energy Conversion
3-0-3. Prerequisites: ECE 2040 and ECE 3025.
This course serves as an introduction to three-phase power systems, electromechanical energy conversion, and operating principles of electric machines.

ECE 3075. Random Signals
3-0-3. Prerequisites: ECE 2025 and (ISYE 3770 or MATH 3770).
Study of random variables and random processes for applications in electrical and computer engineering. Includes an introduction to statistical filtering, parameter estimation, and Markov processes.

ECE 3080. Semiconductor Devices for Computer Engineering and Telecommunication Systems
3-0-3. Prerequisite: ECE 3040.
Students gain an understanding of the device needs for current and future computers, and fiber optic and wireless communication systems addressing the future needs of high frequency, GHz-range, device operation.

ECE 3085. Introduction to Systems and Controls
3-0-3. Prerequisite: ECE 2040.
Theory of linear time-invariant systems for continuous and discrete time. Laplace and Z-Transforms. Transfer function and state space representations. Introduction to feedback control theory.

ECE 3301. Energy Conversion and Mechatronics
1-2-2. Prerequisites: ECE 3040 or ECE 3710.
Basic methods of measuring electrical and mechanical parameters, electrical machinery, sensors and control, and power electronics.

ECE 3431. Analog Electronics Laboratory
1-3-2. Prerequisites: ECE 3050 and ECE 3042.
Design, analysis, simulation, implementation, and evaluation of advanced electronic circuits. Employs bipolar junction, metal oxide semiconductor and field effect transistors, and some integrated circuits.

ECE 3710. Circuits and Electronics
2-0-2. Prerequisite: PHYS 2212.
An introduction to electric circuit elements and electronic devices and a study of circuits containing such devices. Both analog and digital systems are considered.

ECE 3741. Instrumentation and Electronics Lab
0-3-1. Prerequisite: ECE 3710.
Basic analog and digital electronic circuits and principles. Techniques of electrical and electronic measurements with laboratory instruments.

ECE 3801,-2,-3,-4,-5. Special Topics
Credit hours equal last digit of course number.

ECE 3811-2,-3,-4,-5. Special Topics
Credit hours equal last digit of course number.

ECE 3881,-2,-3,-4. Special Topics
Credit hours equal last digit in course number.

ECE 3891,-2,-3,-4. Special Topics
Credit hours equal last digit in course number.

ECE 3900,-1,-2,-3. Special Problems
Credit hours to be arranged.

ECE 4000. Project Engineering and Professional Practice
2-3-3. Prerequisites: ECON 2100 and ECE 3040 and (ISYE 3770 or MATH 3770).
Project engineering techniques and professional practice issues. Design methods and tools, product life cycle, professional communication skills, and ethical issues in electrical/computer engineering.

ECE 4005. ECE Design Project
2-6-4. Prerequisite: ECE 4000.
Team-oriented major design project in electrical/computer engineering, incorporating engineering standards and realistic design constraints. Requires formal reports and oral presentations.

ECE 4010. Computer Engineering Design
2-9-5. Prerequisites: ECE 3055 and ECE 3060 and ECE 4000 and CS 2330.
Team-oriented major computer engineering design project, including hardware/software integration and trade-offs, engineering standards, and realistic design constraints. Formal reports and oral presentations.

ECE 4020. Bioengineering Design
1-6-3. Prerequisites: ECE 4000 and (CHE 4781 or ECE 4781 or ME 4781).
Students will work in teams in bioengineering design projects. Course lectures will address topics related to the art of the design process and the practical design issues facing the bioengineer.

ECE 4025. Real-Time DSP Implementations Using DSP Microprocessors
2-6-4. Prerequisites: ECE 4000 and ECE 4270.
A team-oriented design course in which students will address all aspects of the total implementation of real-time DSP systems from DSP algorithms to real-time I/O.

ECE 4030. Energy System Design
1-9-4. Prerequisites: ECE 3070 and ECE 4000
Design practices related to power system generation, transmission, and distribution systems. Study of related standards and guides. Major design experience.

ECE 4035. Electromagnetics Design
1-6-3. Prerequisites: ECE 3065 and ECE 4000
Design and evaluation of electromagnetic systems working at radio or microwave frequencies. Typical projects involve antennas, passive and active microwave devices, radio wave propagation, etc.

ECE 4040. Electronics Design Project
1-6-3. Prerequisites: ECE 4000 and (ECE 4415 or ECE 4420 or ECE 4430).
The design, analysis, and testing of electronic circuits and systems in a realistic environment. Engineering teams will be formed to design and test various systems.

ECE 4050. Fiber Optic System Design
1-6-3. Prerequisites: ECE 4000 and ECE 4501.
A multidisciplinary senior design course. Design, evaluation, construction, and testing of components to be assembled into an evolving student-built fiber communication system.

ECE 4055. Systems and Controls II - State Space Design
2-6-4. Prerequisites: ECE 4000 and ECE 4551.
Major design course in control. Projects will include transducer design and modeling, control effort limitations, and performance versus cost. Collaboration with manufacturing and bioengineering encouraged.

ECE 4170. Introduction to HDLs with Applications to Digital System Design
2-3-3. Prerequisite: ECE 2031.
Introduction to hardware description languages and associated methodologies for digital system design. Indepth coverage includes applications to the simulation and synthesis of digital systems.

ECE 4175. Embedded Microcontroller Design
3-3-4. Prerequisite: ECE 2031.
Microcontroller structure, instruction set, addressing modes. Code development by assembly language programming and using an emulator. Programmable timer use, interrupt handlers, and timing.

ECE 4270. Fundamentals of Digital Signal Processing
3-0-3. Prerequisite: ECE 3075.
Introduction to Digital Signal Processing. Sampling Theorem, discrete-time Fourier transform, power spectrum, discrete Fourier transform and the FFT algorithm, z-transform, and digital filter design and implementation.

ECE 4271. Applications of Digital Signal Processing
3-3-4. Prerequisite: ECE 4270.
Applications of DSP in speech, image processing, radar, pattern recognition, and adaptive filtering requiring working software implementations applied to the analysis of real signals.

ECE 4273. Design Synthesis of Application-Specific Signal Processors
2-3-3. Prerequisite: ECE 4270.
Fundamentals of theory and practice of DSP chip design in VHDL. Exposure to tools and environments for chip design, simulation, and verification.

ECE 4320. Power System Analysis and Control
3-0-3. Prerequisite: ECE 3070.
Introduces basic concepts in electric power generation, distribution, system control, and economic operation.

ECE 4321. Power System Engineering
3-0-3. Prerequisite: ECE 4320.
Introduces basic concepts of electric power system design, encompassing protection, stability, and control.

ECE 4330. Power Electronics
2-2-3. Prerequisite: ECE 3040; Co-requisite: ECE 3042.
Introduces power semiconductor devices and power electronic converters, including single-phase and three-phase ac/dc rectifiers, ac voltage controllers, dc/dc converters, and dc/ac inverters.

ECE 4340. Building Electrical Systems and Illumination
3-0-3. Prerequisite: ECE 3070.
Introduction to the elements of electrical systems in building and manufacturing facilities. Introduction to illumination engineering and its application in various types of facilities.

ECE 4360. RF-Microwave Measurement Laboratory
1-3-2. Prerequisite: ECE 3065
RF/microwave measurement theory and techniques. Use of state-of-the-art equipment operating into the GHz range.

ECE 4370. Antenna Engineering
3-0-3. Prerequisite: ECE 3065.
Basic theory, application, and design of a broad range of antennas.

ECE 4390. Introduction to Radar and Electromagnetic Sensing
3-0-3. Prerequisite: ECE 3065.
Introduces students to radar systems, including pulsed, CW, CWFM, and MTI radars. Other techniques for electromagnetic sensing such as radiometry and EM tagging are discussed.

ECE 4391. Electromagnetic Compatibility
3-0-3. Prerequisites: ECE 3025 and ECE 3040.
To study electromagnetic interference and susceptibility of electrical systems, with application to analog and digital circuits.

ECE 4415. RF Engineering I
3-0-3. Prerequisites: ECE 3025 and ECE 3050; Co-requisite: ECE 4360.
Fundamentals of RF engineering. Components at high frequencies, device modeling, amplifiers, lumped-element and microstrip impedance transformation networks, and S-parameter-based design of RF and microwave amplifiers.

ECE 4418. RF Engineering II
3-0-3. Prerequisite: ECE 4415.
Fundamentals learned in RF-I are employed to design the elements of radio receivers, transmitters, and similar systems. Systems analysis, mixers, detectors, power amplifiers, low-noise amplifiers, and oscillators are covered.

ECE 4420. Digital Integrated Circuits
3-0-3. Prerequisite: ECE 3040.
Analysis and design of bipolar and MOS digital integrated circuit families and their applications in modern electronic systems.

ECE 4430. Analog Integrated Circuits
3-0-3. Prerequisite: ECE 3050.
Analysis and design of analog ICs using analytic techniques and CAD tools. Topics include amplifiers, current sources, output circuits, and other analog building blocks.

ECE 4435. Operational Amplifier Design
2-3-3. Prerequisite: ECE 3042.
Analysis and design techniques for utilization of integrated circuit operational amplifiers for applications in electronic systems.

ECE 4445. Audio Engineering
3-0-3. Prerequisite: ECE 3050.
Concepts of acoustics and electroacoustic modeling for the analysis and design of microphones, loudspeakers, and crossover networks. Methods of analysis and design of audio power amplifiers.

ECE 4451. Semiconductor Devices for Wireless and Fiber Communication
3-0-3. Prerequisite: ECE 3080.
Advanced development of semiconductor device theory focusing on optoelectronic emitters, detectors, and high-frequency transistors to provide an understanding of devices used in communications systems.

ECE 4460. Introduction to Electronic Systems Packaging
3-0-3. Prerequisites: ECE 3040 or ECE 3710.
Introduction to packaging technologies, technology drivers, electrical performance, thermal management, materials, optoelectronics, RF integration, reliability, system issues, assembly, and testing.

ECE 4500. Optical Engineering
3-0-3. Prerequisite: ECE 3025.
Introduction to applications of geometric and physical optics to engineering, including optical measurements, matrix methods, instruments, interference, holography, beam optics, Fourier optics, and diffraction.

ECE 4501. Fiber Optics
3-4-5. Prerequisite: ECE 3025.
Combined lecture-laboratory exploration of the technology of fiber optics, with special emphasis on optical fiber communications systems.

ECE 4551. Systems and Controls I
3-3-4. Prerequisite: ECE 3085.
Introduction to feedback control. Root locus and bode design for SISO systems, continuous and discrete. Introduction to state space formulation, continuous and discrete.

ECE 4560. Introduction to Automation and Robotics
3-3-4. Prerequisite: ECE 3085.
Concurrent engineering principles; robotic manipulator kinematics, dynamics, and control; applications of robots in industry, medicine, and other areas; team projects, and hands-on laboratory experience.

ECE 4562. Neural Networks and Fuzzy Logic in Control
2-3-3. Prerequisite: ECE 3085.
Principles of neural networks and fuzzy systems; the MATLAB Neural Network and Fuzzy Logic Toolboxes; examples from system identification, classification, and control; and laboratory experience.

ECE 4570. System Theory for Communication and Control
3-3-4. Prerequisite: ECE 3085.
Study of the basic concepts in linear system theory and numerical linear algebra with applications to communication, computation, control, and signal processing. A unified treatment.

ECE 4601. Communication Systems
3-0-3. Prerequisite: ECE 3075.
Presents the fundamentals of modern digital communication systems and evaluates their performance with realistic channel models.

ECE 4602. Communication Systems Laboratory
0-3-1. Prerequisite: ECE 4601.
Examines the performance of analog and digital telecommunications systems and components.

ECE 4603. Communication Networks
3-0-3. Prerequisite: ECE 3075.
Presents the basic concepts of communication network protocols and their performance analysis.

ECE 4604. Network Design and Simulation
3-3-4. Prerequisite: ECE 4603.
Introduces the principles of Monte Carlo techniques and network simulation, and applies them to design issues in ATM systems.

ECE 4751. Laser Theory and Applications
3-0-3. Prerequisite: PHYS 2212.
Provides an introduction to the theory and applications of laser principles and related instrumentation. Emphasis is on the fundamental principles underlying laser action. Crosslisted with PHYS 4751.

ECE 4752. Integrated Circuit Fabrication
2-3-3. Prerequisite: ECE 3040.
The objective of this course is to give students exposure to the various steps involved in the fabrication of integrated circuits and devices. The course will include a laboratory segment in which students fabricate MOS transistors, diffused resistors, and MOS capacitors from a bare silicon substrate. Crosslisted with CHE 4752.

ECE 4761. Industrial Controls and Manufacturing
3-3-4. Prerequisite: ECE 3085.
Students are introduced to industrial controls and the fundamentals of manufacturing with hands-on experience based on lab projects using industry software and hardware for communications and control. Crosslisted with TFE 4761.

ECE 4781. Biomedical Instrumentation
3-0-3. Prerequisite: ECE 3050.
A study of medical instrumentation from a systems viewpoint. Pertinent physiological and electro-physiological concepts will be covered. Crosslisted with CHE and ME 4781.

ECE 4782. Biosystems Analysis
3-0-3. Prerequisite: MATH 1502.
Analytical methods for modeling biological systems, including white-noise protocols for characterizing nonlinear systems. Crosslisted with CHE and ME 4782.

ECE 4801,-2,-3,-4,-5. Special Topics
Credit hours equal last digit in course number.

ECE 4811,-2,-3,-4,-5. Special Topics
Credit hours equal last digit in course number.

ECE 4823,-33. Special Topics
Credit hours equal last digit in course number.

ECE 4881,-2,-3,-4. Special Topics
0-3-1.

ECE 4891,-2,-3,-4. Special Topics
0-3-1.

ECE 4900,-1,-2,-3. Special Problems
Credit hours to be arranged.

ECE 6100. Advanced Computer Architecture
3-0-3. Prerequisite: ECE 3055.
Comprehensive coverage of the architecture and system issues that confront the design of a high-performance workstation/PC computer architectures with emphasis on quantitative evaluation.

ECE 6101. Parallel and Distributed Computer Architecture
3-0-3. Prerequisite: ECE 6100.
An advanced study of the critical issues and limiting factors in the design of asynchronous and synchronous parallel and distributed architectures.

ECE 6110. CAD for Computer Communication Networks
2-3-3. Prerequisite: ECE 6607
Investigation of the methodologies and algorithms used for designing and optimizing computer/communications networks with a focus on the algorithmic aspects of network design.

ECE 6120. Automata Theory
3-0-3.
The course presents a broad base of topics in modern automata and switching theory. These elements form the essentials upon which modern digital systems are constructed.

ECE 6121. Combinatorial Strategies for Engineers
3-0-3.
Modern counting theory and algorithmic approaches necessary for discrete computation.

ECE 6130. Advanced VLSI Systems
3-0-3. Prerequisite: ECE 3060.
An advanced treatment of VSLI systems analysis, design, and testing with emphasis on complex systems and how they are incorporated into a silicon environment.

ECE 6140. Digital Systems Test
3-0-3. Prerequisite: ECE 3060.
Introduction to the basic concepts in digital systems testing. Advanced topics in fault modeling and simulation, test pattern generation, and design for testability.

ECE 6250. Advanced Digital Signal Processing
3-0-3. Prerequisite: ECE 4270.
An introduction to advanced signal processing methods that are used in a variety of applications areas.

ECE 6254. Statistical Digital Signal Processing and Modeling
3-0-3. Prerequisite: ECE 4270.
Introductory course in digital signal processing, includes the following topics: signal modeling, optimum filters, and power spectrum estimations.

ECE 6255. Digital Processing of Speech Signals
3-0-3. Prerequisite: ECE 4270 or ECE 6250.
The application of digital signal processing to problems in speech communication. Part of this goal requires a laboratory project.

ECE 6258. Digital Image Processing
3-0-3. Prerequisite: ECE 4270.
An introduction to the theory of multidimensional signal processing and digital image processing, including key applications in multimedia products and services, and telecommunications.

ECE 6271. Adaptive Filtering
3-0-3. Prerequisite: ECE 4270.
Basic theory of adaptive filter design and implementation. Steepest descent, LMS algorithms, nonlinear adaptive filters, and neural networks. Analysis of performance and applications.

ECE 6272. Fundamentals of Radar Signal Processing
3-0-3. Prerequisite: ECE 4270.
Signal modeling including radar cross section, multipath, and clutter. Properties of the ambiguity function and coded waveforms. Algorithms for doppler processing, detection, and radar imaging.

ECE 6273. Methods of Pattern Recognition with Application to Voice
3-0-3. Prerequisite: ECE 4270.
Theory and application of pattern recognition with a special application section for automatic speech recognition and related signal processing.

ECE 6276. DSP Hardware Systems Design
2-3-3. Prerequisite: ECE 4270
A study of theory and practice in the design and implementation of DSP algorithms on programmable processors, multiprocessors, and ASICs.

ECE 6277. DSP Software Systems Design
2-3-3. Prerequisite: ECE 4270.
Specification, evaluation, and implementation of real-time DSP applications on embedded DSP-based environments.

ECE 6279. Spatial Array Processing
3-0-3. Prerequisite: ECE 4270.
Introduce application areas where signals are sampled over space and time. Transfer knowledge of time-based techniques to spatial processing. Develop algorithms unique to spatial processing.

ECE 6320. Power Systems Control and Operation
3-0-3. Prerequisite: ECE 4320.
Introduction to methods used in the real-time operation and control of power systems as well as to the hardware and software technology of energy management systems (EMS).

ECE 6321. Power System Stability
3-0-3. Prerequisite: ECE 4320 .
Techniques for stability analysis of electric power systems and applications of these methods.

ECE 6322. Power System Planning and Reliability
3-0-3. Prerequisite: ECE 4320.
Introduces basic concepts as well as analysis and optimization techniques underlying reliability assessment of electric power systems and planning techniques.

ECE 6323. Power System Protection
2-2-3. Prerequisite: ECE 4320 .
Theory and practice of modern power system protection techniques.

ECE 6330. Power Electronic Devices and Subsystems
3-0-3. Prerequisite: ECE 3040
Physical considerations involved in the fabrication and use of power semiconductor devices and high-frequency magnetic transformers and inductors.

ECE 6331. Power Electronic Circuits
3-0-3. Prerequisite: ECE 4330.
The analysis, control, and design of switching power converters: rectifiers, cycloconverters, voltage-sourced and current-source inverters, dc-dc converters, pfc and resonant converters.

ECE 6332. Power Electronic CAD Laboratory
0-3-1. Prerequisite: ECE 6331.
Introduces the use of CAD tools in the simulation, analysis, and design of power electronic circuits and systems.

ECE 6335. Electric Machinery Analysis
3-0-3. Prerequisite: ECE 3070.
An introduction to the analysis and basic construction principles of rotating electric machines and transformers, including ac synchronous and induction machines and dc machines.

ECE 6336. Dynamics and Control of Electric Machine Drives
3-0-3. Prerequisite: ECE 3070.
A study of the dynamics and control of electric machinery and variable-speed machine drive systems.

ECE 6340. Electric Power Quality
2-2-3. Prerequisite: ECE 4320.
Study transients and harmonics in power systems, along with analysis methods and mitigation practices. Understand the causes of power quality problems and relate them to equipment susceptibility.

ECE 6350. Applied Electromagnetics
3-0-3.
The methodology and application of advanced electromagnetic theory.

ECE 6360. Microwave Design
3-0-3.
Applications of electromagnetic theory to microwave components and systems. Introduction to the latest characterization and design techniques including monolithic microwave integrated circuit (MMIC) technology.

ECE 6361. Microwave Design Laboratory
2-3-3. Prerequisite: ECE 6360.
This laboratory course will teach microwave measurement/design fundamentals for both passive and active components. Students will use both CAD tools and network analyzers.

ECE 6370. Electromagnetic Radiation and Antennas
3-0-3. Prerequisite: ECE 6350.
The fundamentals of electromagnetic radiation and antennas.

ECE 6380. Introduction to Computational Electromagnetics
3-0-3.
The practical application of the finite-difference time-domain and finite element techniques to electromagnetic problems. Computer projects are required.

ECE 6390. Satellite Communications and Navigation Systems
3-0-3.
Introduces satellite communications and navigation system design including microwave transmission, satellite transponders, earth station hardware, and satellite networks. A design project is required.

ECE 6412. Analog Integrated Circuit Design
3-0-3. Prerequisite: ECE 4430.
Design of analog circuits using CMOS and bipolar technology.

ECE 6414. Analog Integrated System Design
3-0-3. Prerequisite: ECE 6412.
Design of analog systems using CMOS and bipolar technology. A higher level of design for analog and digital systems is presented.

ECE 6416. Low-Noise Electronic System Design
2-3-3. Prerequisite: ECE 4430.
A study of the sources of noise found in electronic instrumentation. Teaches the recognition of sources of noise and the design techniques to achieve noise reduction.

ECE 6420. Wireless IC Design
3-0-3. Prerequisite: ECE 4430.
Wireless system specifications are translated to architectures and building blocks compatible with silicon technology. The course focuses on the analysis and design of these blocks.

ECE 6430. Digital MOS Integrated Circuits
3-0-3.
Detailed analysis of the operation and design of high-performance MOS digital integrated circuits. Emphasis is on circuit design techniques with examples from the literature.

ECE 6435. Neuromorphic Analog VLSI Circuits
3-0-3. Prerequisite: ECE 3050.
Large-scale analog computation for sensory and motor processing. Analog building blocks are presented, leading to VLSI systems inspired by neurobiological architectures and computational paradigms.

ECE 6440. Frequency Synthesizers
3-0-3.
Frequency synthesizers generate many discrete RF frequencies from one reference frequency. General synthesizers, digital PLL, direct digital, and hybrid synthesizers are covered.

ECE 6442. Electronic Oscillators
3-0-3.
Starting from nonlinear differential equations, this course presents a systematic approach to the design of electronic oscillators. Design of negative resistance and feedback oscillators is discussed. CAD techniques are employed.

ECE 6450. Introduction to Microelectronics Technology
3-0-3.
Presents the fundamentals of microelectronics material, device, and circuit fabrication.

ECE 6451. Introduction to the Theory of Microelectronics
3-0-3.
Basis of quantum mechanics, statistical mechanics, and the behavior of solids to serve as an introduction to the modern study of semiconductors and semiconductor devices.

ECE 6453. Theory of Electronic Devices
3-0-3. Prerequisite: ECE 6451.
Presents the fundamentals of electronic device operation.

ECE 6455. Semiconductor Process Control
3-0-3. Prerequisites: ISYE 3770 or MATH 3770
This course is designed to explore methods of applying statistical process control and statistical quality control to semiconductor manufacturing processes. Students will be required to complete a design project.

ECE 6456. Solar Cells
3-0-3.
Provides a practical understanding of semiconductor materials and technology as they relate to design and development of efficient solar cells and photovoltaic systems.

ECE 6458. Gigascale Integration
3-0-3. Prerequisite: ECE 3080.
Hierarchy of physical principles that enable understanding and estimation of future opportunities to achieve multibillion transistor silicon chips using sub-0.25 micron technology.

ECE 6500. Fourier Techniques and Signal Analysis
3-0-3.
Introduction to the use of Fourier methods for analysis of signals.

ECE 6501. Fourier Optics and Holography
3-0-3. Prerequisite: ECE 6500.
Applications of the Fourier transform and linear systems theory to the analysis of optical propagation, diffraction imaging, holography, wavefront modulation, and signal processing.

ECE 6510. Electro-Optics
3-0-3.
Study of the fundamental principles and primary applications of lasers, and of detectors of optical radiation.

ECE 6520. Integrated Optics
3-0-3.
Theory and design of optical waveguides and optical waveguide devices.

ECE 6521. Optical Fibers
3-0-3.
Provides an in-depth understanding of the light-guiding properties of optical fibers as used in communication systems.

ECE 6522. Nonlinear Optics
3-0-3.
Provides an introduction to the field of nonlinear optics, exploring the physical mechanisms, applications, and experimental techniques.

ECE 6530. Modulation, Diffractive, and Crystal Optics
3-0-3.
Provides a working knowledge of temporal and spatial optical modulation, diffractive optical devices, and crystal optics.

ECE 6542. Optoelectronics: Devices, Integration, Packaging, Systems
3-0-3.
Optoelectronic devices (detectors, emitters, modulators) from the practical realized and theoretical performance perspectives. Explores monolithic and hybrid integration of devices, packaging, and system implementation.

ECE 6543. Fiber Optic Networks
3-0-3.
Architectural, performance, and design aspects of fiber-optic communications networks, components, and technologies. Relationship between the physical network implementation and the higher-level network architecture.

ECE 6550. Linear Systems and Controls
3-0-3.
Introduction to linear system theory and feedback control. Topics include state space representations, controllability and observability, and linear feedback control.

ECE 6551. Digital Control
3-0-3. Prerequisite: ECE 6550.
Techniques for analysis and synthesis of computer-based control systems. Design projects provide an understanding of the application of digital control to physical systems.

ECE 6552. Nonlinear Systems and Control
3-0-3. Prerequisite: ECE 6550.
Classical analysis techniques and stability theory for nonlinear systems. Control design for nonlinear systems, including robotic systems. Design projects.

ECE 6553. Optimal Control and Optimization
3-0-3. Prerequisite: ECE 6550.
Optimal control of dynamic systems, numerical optimization techniques, and their applications in solving optical trajectory problems.

ECE 6554. Adaptive Control
3-0-3. Prerequisite: ECE 6550.
Methods of parameter estimation and adaptive control for systems with constant or slowly varying unknown parameters. MATLAB design projects emphasizing applications to physical systems.

ECE 6555. Optimal Estimation
3-0-3. Prerequisite: ECE 6550.
Techniques for signal and state estimation in the presence of measurement and process noise with the emphasis on Wiener and Kalman filtering.

ECE 6556. Intelligent Control
3-0-3. Prerequisite: ECE 6550.
Principles of intelligent systems and their utility in modeling, identification, and control of complex systems; neuro-fuzzy tools applied to supervisory control; hands-on laboratory experience.

ECE 6557. Manufacturing Systems Design
3-0-3.
Analytic and simulation tools for design, control, and optimization of manufacturing systems. Discrete event dynamic systems and optimization.

ECE 6558. Stochastic Systems
3-0-3. Prerequisites: ISYE 3770 or MATH 3770.
Advanced techniques in stochastic analysis with emphasis on stochastic dynamics, nonlinear filtering and detection, stochastic control, and stochastic optimization and simulation methods.

ECE 6559. Advanced Linear Systems
3-0-3. Prerequisite: ECE 6550.
Study of multivariable linear system theory and robust control design methodologies.

ECE 6601. Random Processes
3-0-3. Prerequisite: ECE 3075.
Develops the theoretical framework for the processing of random signals and data.

ECE 6602. Digital Communications
3-0-3. Prerequisite: ECE 6601.
Basic M-ary digital communications systems, with emphasis on system design and performance analysis in the presence of additive noise.

ECE 6603. Advanced Digital Communications
3-0-3. Prerequisite: ECE 6602.
The theory and practice of efficient digital communications over linear dispersive channels, including adaptive equalization and synchronization.

ECE 6604. Personal and Mobile Communications
3-0-3. Prerequisite: ECE 6602.
Introduces various topics that are fundamental to cellular mobile telephone systems.

ECE 6605. Information Theory
3-0-3. Prerequisite: ECE 3075
Introduces the mathematical theory of communications. Emphasis will be placed on Shannon's theorems and their use in the analysis and design of communication systems.

ECE 6606. Coding Theory and Applications
3-0-3. Prerequisite: ECE 3075.
Introduces the theory and practice of error control coding, with emphasis on linear, cyclic, convolutional, and parallel concatenated codes.

ECE 6607. Computer Communication Networks
3-0-3.
Fundamental concepts of computer network architecture and protocols.

ECE 6608. Performance Analysis of Communications Networks
3-0-3. Prerequisites: ECE 6601 and ECE 6607
Fundamental concepts of queueing systems, and applications of queueing theory to the performance evaluation of computer networks.

ECE 6609. ATM Networks
3-0-3. Prerequisite: ECE 6607.
Fundamental concepts of high-speed networking and switching.

ECE 6610. Wireless Networks
3-0-3. Prerequisite: ECE 6607
Fundamental concepts of wireless networks.

ECE 6759. Plasma Processing of Electronic Materials and Devices
3-0-3.
Fundamental physics, chemistry, chemical engineering, and electrical engineering principles inherent in plasma processes. Includes etching, deposition, diagnostic methods, and control schemes. Crosslisted with CHE 6759.

ECE 6771. Optoelectronics: Materials, Processes, Devices
3-0-3.
Optoelectronic materials, physical processes, and devices. Includes compound semiconductor materials, excitation, recombination, gain, and modulation processes and devices such as emitters, detectors, and modulators. Crosslisted with PHYS 6771.

ECE 6780. Medical Image Processing
3-0-3. Prerequisites: BMED 6786 or ECE 6786.
A study of methods for enhancing, analyzing, interpreting, and visualizing information from two- and three-dimensional data obtained from a variety of medical imaging modalities. Crosslisted with CS and BMED 6780.

ECE 6786. Medical Imaging Systems
3-0-3.
A study of the principles and design of medical imaging systems such as X-ray, ultrasound, nuclear medicine, and nuclear magnetic resonance. Crosslisted with BMED 6786.

ECE 6787. Quantitative Electrophysiology
3-0-3.
A quantitative presentation of electrophysiological systems in biological organisms, emphasizing the electrical properties and modeling of neural and cardiac cells and systems. Crosslisted with BMED and PHYS 6787.

ECE 6788. Legal Issues in Biomedical Engineering
3-0-3.
Study and analysis of U.S. government laws applicable to the development and clinical use of biomedical engineering technology. Crosslisted with BMED, CHE, ME, and MGT 6788.

ECE 6789. Technology Transfer in Biomedical Engineering
3-0-3.
Team discussion and case studies in biomedical engineering technology transfer, including licensing, financial capital, safety and efficacy studies, clinical trials, and strategic planning. Crosslisted with BMED, CHE, ME, and MGT 6789.

ECE 6793. Systems Pathophysiology
3-0-3.
Overview of human pathophysiology from a quantitative perspective. A brief introduction to the application of quantitative models to the understanding of biological systems. Crosslisted with BMED, CHE, and ME 6793.

ECE 7000. Master's Thesis
Credit hours to be arranged.

ECE 7102. RISC Architectures
3-0-3. Prerequisite(s): ECE 6100.
An advanced design-oriented class studying the design techniques and operational principles of modern Superscalar RISC datapaths.

ECE 7131. Asynchronous and Self-Timed Systems
3-0-3. Prerequisite: ECE 6130.
Specification and design of asynchronous digital systems.

ECE 7141. Advanced Digital Systems Test
2-3-3. Prerequisite: ECE 6140.
Design and test techniques for high-speed digital systems operating at rates above 100 MHz with a practical emphasis via substantial projects.

ECE 7142. Fault-Tolerant Computing
3-0-3. Prerequisite: ECE 6140.
Key concepts in fault-tolerant computing. Understanding and use of modern fault-tolerant hardware and software design practices. Case studies.

ECE 7251. Signal Detection and Estimation
3-0-3. Prerequisite: ECE 6250.
Detection theory and estimation theory and their application to communications and statistical signal processing problems.

ECE 7252. Advanced Signal Processing Theory
3-0-3. Prerequisite: ECE 6250.
A lecture and seminar treatment of the latest developments in signal processing. Emphasis is placed on current literature and emerging research areas.

ECE 7370. Antennas and Wave Propagation in Matter
3-0-3. Prerequisite: ECE 6350.
Basic methods for characterizing the electromagnetic properties of common materials (geophysical, biological, etc.) and techniques for analyzing antennas and wave propagation in these materials.

ECE 7380. Topics in Computational Electromagnetics
3-0-3. Prerequisite: ECE 6350.
Computational approaches for applications such as radar signature prediction, microwave antenna and device design, and modeling techniques for electronic packaging.

ECE 7611. Advanced Communication Theory
3-0-3.
Latest developments in communications and networking are treated in lecture and seminar. Emphasis on current literature and open research areas.

ECE 8001,-2,-3. ECE Seminar
1-0-1, each.
Speakers with diverse backgrounds and representing many different industries, professions, and institutions describe their experiences, entrepreneurial ventures, and research challenges.

ECE 8010. Research Seminar
1-0-1.
Seminar presentations describing ECE-related research projects, centers, and other activities at Georgia Tech.

ECE 8801,-2,-3,-4,-5. Special Topics
Credit hours equal last digit in course number.

ECE 8811,-2,-3,-4,-5. Special Topics
Credit hours equal last digit in course number.

ECE 8823,-33,-43,-53,-63,-73. Special Topics
3-0-3, each.

ECE 8881,-2,-3,-4. Special Topics-Laboratory
Credit hours equal last digit in course number.

ECE 8891,-2,-3,-4. Special Topics-Laboratory
Credit hours equal last digit in course number.

ECE 8900,-1,-2,-3. Special Problems
Credit hours to be arranged.

ECE 8997. Teaching Assistantship
Credit hours to be arranged.
For students holding graduate teaching assistantships.

ECE 8998. Research Assistantship
Credit hours to be arranged.
For students holding graduate research assistantships.

ECE 9000. Doctoral Thesis
Credit hours to be arranged.

School of Industrial and Systems Engineering

School established in 1945, Department in 1924
Location: Groseclose Building
Telephone: (404) 894-2300
FAX: (404) 894-2301
Website: www.isye.gatech.edu

Chair and Professor–John J. Jarvis; *Director of Academic Programs and Professor*–R. Gary Parker; *Director for Academic Support*–Donna C. Llewellyn; *A. Russell Chandler III Chair and Professor*–George L. Nemhauser; *Coca-Cola Chair and Professor*–Ellis L. Johnson; *Eugene C. Gwaltney Jr. Chair in Manufacturing Systems*–(vacant); *UPS and Regents' Professor*–H. Donald Ratliff; *Professors*–Earl R. Barnes, John J. Bartholdi III, John P. Crecine, Jim Dai, Augustine O. Esogbue, Jack R. Lohmann, Leon F. McGinnis Jr., Christine M. Mitchell, Alan L. Porter, William B. Rouse (adjunct), Richard L. Serfozo, Alexander Shapiro, Michael E. Thomas, Craig A. Tovey; *Professors Emeriti*–Jerry Banks, Leslie G. Callahan, David E. Fyffe, William W. Hines, Cecil G. Johnson, Lynwood A. Johnson, Robert N. Lehrer (director emeritus), Nelson K. Rogers, C.M. Shetty, Rocker T. Staton, Gerald J. Thuesen, Harrison M. Wadsworth; *Associate Professors*–Christos Alexopoulos, Faiz Al-Khayyal, Jane C. Ammons, Sigrun Andradottir, Robert D. Foley, Marc Goetschalckx, David Goldsman, T. Govindaraj, Paul M. Griffin, Steven T. Hackman, Anthony J. Hayter, Russell G. Heikes, Alexander C. Kirlik, Milena Mihail, Renato Monteiro, Justin A. Myrick, Loren K. Platzman (adjunct), Frank E. Roper, Martin Savelsbergh, Gunter P. Sharp, Mark Spearman, Kwok Tsui, John H. VandeVate, Donovan B. Young, Chen Zhou; *Associate Professor Emeritus*–Willard R. Fey; *Assistant Professors*–Hayriye Ayhan, Victoria Chen, Lloyd Clarke, Doug Down, Pinar Keskinocak, Anton Kleywegt, Paul Kvam, Michael Massimino, Amy Pritchett, Spyros Reveliotis; *Director, Logistics Learning Center*–Harvey Donaldson.

General Information

Industrial and systems engineering is a branch of engineering that deals with the description, evaluation, design, modification, control, and improvement of the performance of complex systems. The field is unique in its identification of human beings as central contributors to the inherent complexity of such systems, but also as the primary targets and benefactors of their analysis and anticipated improvement. Students in the program are typically interested in obtaining a fundamental engineering background as a basis for the subsequent professional specialization in the various activities associated with the field. Among these are operations research, systems analysis, distribution and logistics, production, manufacturing, planning, quality control, economic and financial modeling, and others. Graduates can be found in a host of settings including transportation, telecommunications, hospitals, banking and finance, environmental systems, retailing, and consulting. The degree program offered is the Bachelor of Science in Industrial Engineering (BSIE).

Undergraduate Program

Bachelor of Science in Industrial Engineering

The principal strength of the academic program leading to the BSIE is its blend of fundamental topics in mathematics and the physical and engineering sciences that are common to all engineering disciplines coupled with specialized study in subject areas such as optimization, probability and statistics, computing, economics, and psychology. It is precisely this blend that produces the flexibility that is inherent in the field of industrial engineering and that affords BSIE graduates a wide array of career options.

Options for Exceptional Students

Program activities and options are available to encourage and reward students with superior records and abilities. Participation in these programs requires demonstrated scholastic excellence and prior arrangement with the student's advisor and/or the director of Academic Programs.

Graduate-level Courses

Students with a cumulative grade point average of 3.3 or above may schedule up to 9 credit hours of approved graduate-level courses. These credits, when approved by the director of Academic Programs, may apply subsequently toward a graduate degree. Specific details regarding the latter are available in the Office of Academic Programs.

Honors Courses

The School offers Honors versions of some of the required courses for the BSIE. Students with a cumulative grade point average of at least 3.2 are allowed to enroll in these courses and use them as replacements for the analogous course requirements in the curriculum.

Visiting Scholar/Practitioner Offerings

Occasionally, the School brings to campus selected individuals of unique accomplishment for course offerings built around their special areas of activity, thus making available a broader range of course materials than regularly provided. Prominent in this regard is the James C. Edenfield Executive-in-Residence program, which brings highly successful executives to the School. Participating much like visiting faculty, these executives bring to a classroom setting, both graduate and undergraduate, the benefit of their work experiences as they support the ISyE curriculum.

Bachelor of Science in Industrial Engineering Curriculum (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
MATH 1501	CALCULUS I	4
ENGL 1101	COMPOSITION I	3
PSYC 1101	GENERAL PSYCHOLOGY	3
LAB SCIENCE ELECTIVE (CHEM, BIOL, EAS)		4
TOTAL SEMESTER HOURS		14

First Year - Spring Semester

Course Number/Name		*Hours*
MATH 1502	CALCULUS II	4
ENGL 1102	COMPOSITION II	3
PHYS 2211	PHYSICS I	4
CS 1301	COMPUTER SCIENCE I	3
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS		16

Second Year - Fall Semester

Course Number/Name		*Hours*
MATH 2401	CALCULUS III	4
PHYS 2212	PHYSICS II	4
CS 1302	COMPUTER SCIENCE II	3
ISYE 2027	PROBABILITY	3
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		17

Second Year - Spring Semester

Course Number/Name		*Hours*
MATH 2602	LINEAR & DISCRETE MATH	4
ECON 2100	ECON. ANALYSIS	3
ISYE 2030	MODELS IN IE	3
ISYE 2028	STATISTICS	3
LAB SCIENCE ELECTIVE (CHEM, BIOL, EAS, PHYS) [1]		4
TOTAL SEMESTER HOURS		17

Third Year - Fall Semester

Course Number/Name		*Hours*
ISYE 3025	ENGINEERING ECONOMY	1
ISYE 3039	QUALITY METHODS	3
ISYE 3101	LOGISTICS	4
ISYE 3232	STOCHASTIC MFG. & SERVICE SYS.	3
CS 4400	DATABASE SYSTEMS	3
LCC HUMANITIES ELECTIVE (COMMUNICATIONS) [3]		3
TOTAL SEMESTER HOURS		17

Third Year - Spring Semester

Course Number/Name		*Hours*
ISYE 3044	SIMULATION	3
ISYE 3102	MFG. & WAREHOUSING	4
ECON 3150 or MGT 3078		3
ENGINEERING ELECTIVE [2]		3
FREE ELECTIVE		3
TOTAL SEMESTER HOURS		16

Fourth Year - Fall Semester

Course Number/Name		*Hours*
ISYE 4009	HUMAN INTEGRATED SYSTEMS	3
ISYE 4104	SENIOR DESIGN I	2
ISYE 4231	ENGR. OPTIMIZATION	3
ENGINEERING ELECTIVE [2]		3
HUMANITIES ELECTIVE [3]		3
FREE ELECTIVE		3
TOTAL SEMESTER HOURS		17

Fourth Year - Spring Semester

Course Number/Name		*Hours*
ISYE 4105	SENIOR DESIGN II	2
MGT 3101 or MGT 3150		3
ENGINEERING ELECTIVE[2]		3
SOCIAL SCIENCE ELECTIVE		3
FREE ELECTIVE		3
TOTAL SEMESTER HOURS		14

TOTAL PROGRAM HOURS = 126 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Electives

(1) Science electives I and II are selected from courses in Physics, Chemistry, Biology, and/or Earth and Atmospheric Sciences.

(2) Engineering science electives are taken from {Thermo, Statics/Dynamics, Circuits, DSP}.

(3) One of the humanities electives must be denoted as "communicatons intensive."

(4) Among all science and free electives, at least one course must be on the environment.

To satisfy the state requirements regarding course work on the history and constitutions of the U.S. and Georgia, students must complete one of the following courses: HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200.

Graduate Programs

Master's Programs

The School of Industrial and Systems Engineering offers five master's degrees: the Master of Science in Industrial Engineering (MSIE); the Master of Science in Operations Research (MSOR); the Master of Science in Statistics (MSS), offered jointly with the School of Mathematics; the Master of Science in Health Systems (MSHS); and the undesignated Master of Science (MS). It also offers the Doctor of Philosophy.

The MSIE program is available to students with an industrial engineering background and to other engineers who satisfy requirements covering the principal subject matter of the current BSIE curriculum. The MSOR, MSS and MSHS programs are available for students holding the BS in engineering, mathematics, or science. Requisites include work in probability, statistics, linear algebra, calculus, and optimization, as well as selected application area work. The student may satisfy these requirements after enrollment; however, such course work may not apply toward fulfillment of the degree requirements. The undesignated MS program is for those students who wish to work in the area of human-integrated systems.

All proposed master's degree programs require 30 semester hours; one option, the undesignated MS in Human-Integrated Systems, requires a thesis. In addition, the MSIE allows a choice of two tracks. One of these accommodates advanced study in modern manufacturing, warehousing, and logistics while the second allows for a concentration in human-integrated systems analysis.

Video-Based Master's Program

The School of Industrial and Systems Engineering offers off-campus working professionals the opportunity to enroll in many of its graduate courses through video technologies. Qualified individuals can complete the requirements for the master's degree utilizing the video-based delivery system. Admission as a degree-seeking student in the video program is based upon the same criteria as for regular students. See "Video-based Instruction" on p. 36.

Program in Statistics

The Master of Science in Statistics is offered through joint cooperation between the School of Industrial and Systems Engineering and the School of Mathematics. The nature of this relationship emphasizes statistics as a science necessary in a technological environment. Within this program, students may concentrate their studies on a specific area of application such as engineering, quality control, or management. Although this program can lead to further work toward a doctorate in statistics, it will primarily provide the background requisite for a professional career in statistics.

Doctoral Programs

The Ph.D. program is intended for highly qualified individuals for whom past accomplishments and evaluation indicate a high potential for successful completion of the program requirements and a subsequent creative intellectual contribution to the field. Admission is, therefore, dependent upon student qualification rather than educational background in any specified discipline. Consideration for admission is based largely upon performance in prior academic work, the Graduate Record Examination (GRE), and credible letters of reference. Admitted students may pursue their work in any of six tracks: optimization, stochastic systems, manufacturing/ logistics, economic decision analysis, applied statistics, and human-integrated systems.

Program in Algorithms, Combinatorics, and Optimization

The Ph.D. program in algorithms, combinatorics, and optimization (ACO) is a multidisciplinary graduate program sponsored jointly by the School of Industrial and Systems Engineering, the College of Computing, and the School of Mathematics. The program is arranged to bring together the study of discrete structures and the design and analysis of algorithms in areas such as graph theory, integer programming, combinatorial optimization, network flows, and polyhedral theory. It is intended for students possessing a strong mathematical perspective and background in one or more of the fields represented by the sponsoring units.

Each student in the ACO program will have a single home department chosen from among the participating units, all of which contribute courses for the program. Students may apply to the ACO program at Georgia Tech through any one of these three units.

Financial aid for Ph.D. study is available in the form of traineeships, fellowships, sponsored externships, and research and teaching assistantships.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

HEALTH SYSTEMS

HS 4001. Introduction to Health Systems
3-0-3.
Background of US healthcare; the workforce; mechanisms and costs of delivery; facilities; ambulatory care; regulation and quality; managed care, finance, and role of government.

HS 6000. Introduction to Healthcare Delivery
3-0-3.
Historical background; the healthcare workforce; nature, problems, and costs of delivery sites; health planning, finance, role of government, alternative delivery models, and health policy.

HS 6100. Healthcare Delivery Systems Models
3-0-3. Prerequisite: HS 6000.
Progression in service delivery from indtvidual providers to complex financing and delivery organizations. Alternative models are explored with an emphasis on access, efficiency, and effectiveness.

HS 6200. Healthcare Financial Management
3-0-3. Prerequisite(s). HS 6000
Applications of accounting and finance in the healthcare delivery system; methods of reimbursement, product costing, strategic financial planning, and capital formation.

HS 6300. Healthcare Information Systems
3-0-3. Prerequisite(s): HS 6000.
Application of information systems to assist in medical practice including communication within the healthcare enterprise, reimbursement for care, clinical decision making, and assessment of outcomes.

HS 6400. Health Systems Practice
3-0-3. Prerequisite(s): HS 6000 and HS 6100.
An actual project conducted by individual graduate students within a healthcare institution or a health service organization. Project has both a faculty and site sponsor

HS 8800,-1. Special Topics
3-0-3, each.

HS 8900,-1. Special Problems
Credit hours to be arranged.

HS 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding graduate teaching assistantships.

HS 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding graduate research assistantships.

INDUSTRIAL AND SYSTEMS ENGINEERING

ISYE 2027. Probability with Applications
3-0-3. Prerequisite: MATH 1502.
Topics include conditional probability, density and distribution functions from engineering, expectation, conditional expectation, laws of large numbers, central limit theorem, and introduction to Poisson Processes.

ISYE 2028. Basic Statistical Methods
3-0-3. Prerequisite: ISYE 2027 AND CS 1302.
Point and interval estimation of systems parameters, statistical decision making about differences in system parameters, analysis and modeling of relationships between variables.

ISYE 2030. Modeling in Industrial Engineering
2-3-3. Prerequisites: CS 1302 and ISYE 2027 and MATH 2401; Co-requisite: ISYE 2028.
Coverage includes projects involving information collection, data acquisition, analysis, and presentation as well as the motivation and use of analytical algorithmic, conceptual, and computational models.

ISYE 2127. Honors Probability
3-0-3. Prerequisite: MATH 1502.
Topics parallel those in ISYE 2027 with an intended treatment that is more innovative and challenging. Credit not allowed for both ISYE 2127 and 2027.

ISYE 2128. Honors Statistics
3-0-3. Prerequisites: CS 1302 and ISYE 2027.
Topics parallel to those in ISYE 2028 with an intended treatment that is more innovative and challenging. Credit not given for both ISYE 2028 and 2128.

ISYE 3025. Essentials of Engineering Economy
1-0-1. Prerequisite: ECON 2100.
Introduction to engineering economic decision making, economic decision criteria, discounted cash flow, replacement and timing decisions, risk, depreciation, and income tax.

ISYE 3039. Methods of Quality Improvement
3-0-3. Prerequisite: ISYE 2028.
Topics include quality system requirements, designed experiments, process capability analysis, measurement capability, statistical process control, and acceptance sampling plans.

ISYE 3044. Simulation Analysis and Design
3-0-3. Prerequisites: ISYE 2028 and ISYE 3232.
Discrete event simulation methodolgy emphasizing the statistical basis for simulation modeling and analysis. Overview of computer languages and simulation design applied to various industrial situations.

ISYE 3101. Introduction to Supply Chain Modeling: Logistics
3-3-4. Prerequisites: ISYE 2028 and ISYE 2030.
Course focuses on engineering design concepts and optimization models for logistics decision making in three modules: supply chain design, chain planning and execution, and transportation.

ISYE 3102. Introduction to Supply Chain Modeling: Manufacturing and Warehousing
3-3-4. Prerequisites: ISYE 2028 and ISYE 3232.
Design and operation of manufacturing and warehousing facilities.

ISYE 3232. Stochastic Manufacturing and Service Systems
3-0-3. Prerequisite: ISYE 2027
Methods for describing stochastic movements of material in manufacturing facilities, supply chain, and equipment maintenance networks. Includes analysis of congestion, delays, and inventory ordering policies.

ISYE 3332. Honors Random Systems
3-0-3. Prerequisite: ISYE 2027
Topics parallel those in ISYE 3232 with an intended treatment that is more innovative and challenging. Credit not allowed for both ISYE 3332 and 3232.

ISYE 3770. Statistics and Applications
3-0-3. Prerequisite: MATH 2401
Introduction to probability, probability distributions, point estimation, confidence intervals, hypothesis testing, linear regression, and analysis of variance. Crosslisted with MATH 3770.

ISYE 3790. Introduction to Cognitive Science
3-0-3.
Multidisciplinary perspectives on cognitive science. Interdisciplinary approaches to issues in cognition, including memory, language, problem solving, learning, perception, and action. Crosslisted with CS, PST, and PSYC 3790.

ISYE 4009. Design of Human-Integrated Systems
3-0-3. Prerequisites: ISYE 2028 and CS 1302.
Topics include general cognitive systems engineering concepts and principles, and specific concepts and principles of interface design, task analysis, prototyping, and empirical usability of evaluation methods.

ISYE 4104. Senior Design I
0-6-2. Prerequisites: ISYE 3044, ISYE 3101, ISYE 3102 and CS 1302; Co-requisite: ISYE 4231.
Senior ISYE design project requiring students to formulate project plan with off-campus enterprise. Includes specific milestones, targets, and evaluation criteria.

ISYE 4105. Senior Design II
0-6-2. Prerequisite: ISYE 4104.
Part two of senior design project requiring students to formulate project plan with off-campus enterprise. Includes specific milestones, targets, and evaluation criteria.

ISYE 4231. Engineering Optimization
3-0-3. Prerequisites: CS 1302 and MATH 2602.
Topics include modeling with networks and graphs, linear, nonlinear programming, and integer programming; construction of models employing modern modeling languages, and general solution strategies.

ISYE 4256. Applications of Robotics and Automated Data Collection
2-3-3. Prerequisites: CS 1302 and MATH 2602 and ISYE 2028.
Topics include robot configurations, accuracy and analysis, programming, sensors and integration. The latter will focus on automated indentification, automated materials tracking in manufacturing and logistics systems.

ISYE 4331. Honors Optimization
3-0-3. Prerequisites: CS 1302 and MATH 2602.
Topics parallel those in ISYE 4231 with an intended treatment that is more innovative and challenging. Credit not given for both ISYE 4331 and 4231.

ISYE 4756. Technology Forecasting and Assessment
3-0-3.
Develops skills in methods for technology monitoring, forecasting, and assessment; draws on examples in various emerging technologies. Collection and analysis of quantitative and qualitative data on emerging technologies and their implications. Crosslisted with PUBP 4756

ISYE 4790. Seminar in Cognitive Science
3-0-3.
A seminar-type course in cognitive science focusing on integrating and deepening students' cognitive science knowledge and skills. Topics include memory, language, problem solving, learning, perception, and action. Crosslisted with CS, PST, and PSYC 4790.

ISYE 4791. Integrative Project in Cognitive Science
3-0-3.
An integrative course in cognitive science focusing on the integration and use of concepts and skills from cognitive science. A different integrative project or set of projects will be taken on each semester; students will contribute on the basis of their background and skills. Crosslisted with CS, PST, and PSYC 4791

ISYE 4792. Design Project in Cognitive Science
3-0-3.
Individual project with a cognitive science faculty member, designed as a supplement to the student's senior design project or thesis in their major area. Crosslisted with CS, PST, and PSYC 4792.

ISYE 4803,-13,-23. Special Topics
3-0-3, each.
Courses in special topics of timely interest to the profession conducted by resident or visiting faculty.

ISYE 4833. Honors Topics
3-0-3.
Topics of current interest in the field of ISYE that are covered with an appropriately high level of innovation and rigor

ISYE 4991,-2,-3. Special Problems
Credit hours to be arranged
A variable hour credit opportunity to develop initiative and apply fundamental principles by performing semioriginal laboratory or research work in ISYE.

ISYE 6101. Organizational Behavior for Engineers
3-0-3.
Studies the scientific generation, formalization, and application of the knowledge of individual and group behaviors that engineers need to function effectively within contexts.

ISYE 6201. Manufacturing Systems
3-0-3. Prerequisites: ISYE 6650 and ISYE 6669.
Topics include analysis of flows, bottlenecks and queueing, types of operations, manufacturing inventories, aggregreate production planning, lot sizes and lead times, and pull production systems.

ISYE 6202. Warehousing Systems
3-0-3. Prerequisite: ISYE 6669.
Topics include design and analysis of materials handling systems, warehouse layout, order picking strategies, warehousing inventories, warehouse management systems, integration of production and distribution systems.

ISYE 6203. Transportation and Supply Chain Systems
3-0-3. Prerequisite: ISYE 6669.
Topics include supply chain characterization, site location, mode selection, distribution planning, vehicle routing, demand management, replenishment management, geographic information systems, and real-time control issues.

ISYE 6205. Cognitive Engineering
3-0-3.
Application of cognitive science concepts to system design, and the development of concepts appropriate for understanding and aiding cognition in naturally or technologically complex environments.

ISYE 6215. Models in Human-Machine Systems
3-0-3. Prerequisite: ISYE 4009.
The development and use of mathematical models of human behavior are considered. Approaches from estimation theory, control theory, queueing theory, fuzzy set theory are considered.

ISYE 6223. Understanding and Supporting Human Decision Making
3-0-3. Prerequisite: ISYE 4009.
Prescriptive and descriptive theories of human decision making are discussed/contrasted. Approaches to aiding human decision making are considered in context of these theoretical frameworks.

ISYE 6224. Topics in Human-Integrated Systems
3-0-3. Prerequisites: ISYE 4009 or ISYE 6215.
State-of-the-art research directions including supervisory control models of human command control tasks; human-computer interface in scheduling and supervision of flexible manufacturing systems.

ISYE 6225. Engineering Economy
3-0-3. Prerequisites: ISYE 3025 and ISYE 4231.
Advanced engineering economy topics, including economic worth, economic optimization under constraints, risk and uncertainty, foundations of utility theory.

ISYE 6229. Productivity Measurement and Analysis
3-0-3. Prerequisites: ISYE 6401 and ISYE 6669.
Modern measurement of productivity measurement and analysis including principles, issues, and latest techniques associated with benchmarking, efficiency measurement, and productivity tracking. Empirical studies and group projects.

ISYE 6230. Economic Decision Analysis
3-0-3. Prerequisite: ISYE 6669.
Topics include preferences and utilities, social choice, equlibrium concepts, non-cooperative and cooperative game theory, price mechanisms, auction mechanisms, voting theory, and incentive compatibility.

ISYE 6231. Design of Human-Integrated Systems
3-0-3. Prerequisite: ISYE 4009.
Analysis and design of complex work domains in technological environments.

ISYE 6232. Safety-Critical Real-Time Systems
3-0-3. Prerequisite: ISYE 4009.
Study of system safety, human error, and software reliability.

ISYE 6234. Measurement and Evaluation of Human-Integrated Systems
3-0-3. Prerequisite: ISYE 6739.
Measurements of complex systems including workload, operator strategy, and performance.

ISYE 6307. Scheduling Theory
3-0-3. Prerequisite: ISYE 6669.
Includes topics in sequencing and scheduling with emphasis on deterministic machine scheduling problems with some stochastic results examined. Complexity of various problems will be analyzed.

ISYE 6401. Statistical Modeling and Design of Experiments
3-0-3. Prerequisite: ISYE 6739.
Fundamental coverage of topics in multiple regression and factorial experiments.

ISYE 6402. Time Series Analysis
3-0-3. Prerequisite: ISYE 6739.
Basic forecasting methods, ARIMA models, transfer functions.

ISYE 6404. Nonparametric Data Analysis
3-0-3. Prerequisite: ISYE 6739.
Nonparametric statistics and basic catagorical data analysis.

ISYE 6405. Statistical Methods for Manufacturing Design and Improvement
3-0-3. Prerequisite: ISYE 6401.
Fractional factorial designs, response surface methods.

ISYE 6411. Fundamentals of Statistics with Applications
3-0-3. Prerequisite: MATH 2401.
Relationships of statistical estimation and linear models with regression, planning and analysis of experiments, and the analysis of correlated data. More mathematical than ISYE 6401.

ISYE 6644. Simulation
3-0-3. Prerequisite: ISYE 2028.
Covers modeling of discrete-event dynamic systems and introduces methods for using these models to solve engineering design and analysis problems.

ISYE 6650. Probabilistic Models and Their Applications
3-0-3. Prerequisite: ISYE 2027.
An introduction to basic stochastic processes such as Poisson and Markov processes and their applications in areas such as inventory, reliability, and queueing.

ISYE 6656. Queueing Theory
3-0-3. Prerequisite: ISYE 6650.
Processing networks with queueing. Performance analysis using Markov process description of system behavior. Applications and numerical studies in manufacturing, system maintainability, computer systems, telecommunication networks.

ISYE 6661. Optimization I
3-0-3. Prerequisite: MATH 2402.
Linear programming, network flows, issues in combinatorial optimization such as enumerative procedures and complexity, nonlinear optimization including optimality conditions and relaxations. Intended for Ph.D. students.

ISYE 6662. Optimization II
3-0-3. Prerequisite: ISYE 6661
Follow-on treatment of topics from ISYE 6661. Included are polyhedral descriptions, cuts, and interior point methods of optimization. This course is intended for Ph.D students.

ISYE 6664. Stochastic Optimization
3-0-3. Prerequisites: ISYE 6762 or MATH 6762.
An introduction to sequential decision making under uncertainty. Much of the course is devoted to the theoretical, modeling, and computational aspects of Markov decision processes.

ISYE 6669. Deterministic Optimization
3-0-3. Prerequisite: ISYE 4231.
An introduction to deterministic optimization methodologies including approaches from linear, discrete, and nonlinear optimization including algorithms and computations. Applications will be introduced as appropriate.

ISYE 6679. Computational Methods
3-0-3. Prerequisite: ISYE 6669.
Strategies and techniques for converting optimization theory into effective computational procedures. Emphasis is on applications in linear, integer, and nonlinear programming; networks and graphs.

ISYE 6739. Basic Statistical Methods
3-0-3. Prerequisite: MATH 2401.
Overview of basic tools used in statistical analysis and modeling. Credit not allowed to students seeking a degree in ISYE.

ISYE 6761. Stochastic Processes I
3-0-3. Prerequisite: ISYE 2027.
Discrete time Markov chains, Poisson and renewal processes; transient and limiting behavior; average cost and utility measures of systems. Intended for Ph.D. students. Crosslisted with MATH 6761.

ISYE 6762. Stochastic Processes II
3-0-3. Prerequisite: ISYE 6761 or MATH 6761.
Continuous time Markov chains; uniformization, transient and limiting behavior; Brownian motion and martingales; optional sampling and convergence. Intended for Ph.D. students. Crosslisted with MATH 6762.

ISYE 6772. Managing Resources of the Technological Firm
3-0-3.
This course explores the competitive advantage manufacturing and service firms derive from the effective management of their technology, workforce, materials, and information resources. Crosslisted with MGT 6772.

ISYE 6773. Strategic Management of Technology-Based Ventures
3-0-3.
This course provides a forum for the in-depth examination of issues involving the strategic management of high-tech corporate start-ups and small technology-based businesses. Crosslisted with MGT 6773.

ISYE 6774. Management of Technology Project
3-0-3.
This course organizes students into multidisciplinary teams devoted to solving a real problem for a technology-based firm. Crosslisted with MGT 6774.

ISYE 6775. Management of Technology Seminar
1-0-1
This course introduces the frontiers of key technologies, provides a forum for visiting speakers from the corporate world, and supplements topics from other MOT courses. Crosslisted with MGT 6775.

ISYE 6777. Analysis of Emerging Technologies
3-0-3.
Methods for technology monitoring, forecasting, and assessment. Crosslisted with PUBP 6777.

ISYE 6779. Dynamic System Simulation and Modeling
3-0-3. Prerequisite: AE 2220.
Models of dynamic systems, such as aircraft, gound vehicles and machinery, and manual control. Numerical simulation techniques and applications. Interactive simulators. Student programming project. Crosslisted with AE 6779.

ISYE 6781. Reliability Theory
3-0-3. Prerequisite: MATH 4215.
Structural properties and reliability of coherent systems.

ISYE 6795. Introduction to Cognitive Science
3-0-3.
Multidisciplinary perspectives on cognitive science. Interdisciplinary approaches to issues in cognition, including memory, language, problem solving, learning, perception, and action. Crosslisted with CS and PSYC 6795.

ISYE 6805. Reliability Engineering
3-0-3. Prerequisite: ISYE 2027
Topics include hazard functions, life distributions, censoring, life tables, nonparametric and parametric estimation and inference, accelerated life testing, structure functions, reliability and maintenance systems, replacement theory.

ISYE 6831. Advanced Simulation
3-0-3. Prerequisite: ISYE 2027 and MATH 6241.
Topics include generalized semi-Markov processes, input and output analysis, random number, variate, and sample path generation, rare event simulation, and optimization via simulation.

ISYE 7000. Master's Thesis
Credit hours to be arranged.
Required of degree candidates in the master's thesis option.

ISYE 7210. Real-Time Interactive Simulation
3-0-3. Prerequisites: ISYE 6215 and ISYE 6831
Principles and laboratory experience in design and implementation of interactive simulations of complex dynamic systems.

ISYE 7400. Advanced Design of Experiments
3-0-3. Prerequisite: ISYE 6401.
Random and mixed models, nested and blocked designs. Intended for Ph.D. students and those seeking the M.S. Stat.

ISYE 7401. Advanced Statistical Modeling
3-0-3. Prerequisite: ISYE 6401
Nonlinear models, logistic regression, loglinear models. Intended for Ph.D. students and those seeking the M.S. Stat.

ISYE 7405. Multivariate Data Analysis
3-0-3. Prerequisite: ISYE 6401
Multivariate ANOVA, principle components, factor analysis etc. Intended for Ph.D. students and those seeking the M.S. Stat.

ISYE 7441. Theory of Linear Models
3-0-3. Prerequisites: MATH 4261 and ISYE 6401
Intended for Ph.D. students and those seeking the M.S. Stat.

ISYE 7653. Case Studies in Logistics/Manufacturing
3-0-3. Prerequisites: ISYE 6201 and ISYE 6203 and ISYE 6661 and ISYE 6761 or MATH 6761.
Advanced topics in logistics and manufacturing through the use of industrial case studies. Difficult modeling issues such as data representation and consistency will be introduced.

ISYE 7790. Cognitive Modeling
2-6-4. Prerequisites: CS 6795 or ISYE 6795 or PSYC 6795.
A hands-on course covering a range of cognitive methodologies. It explores the analysis, development, construction, and evaluation of models of cognitive processing. Crosslisted with CS and PSYC 7790.

ISYE 8011,-2,-3. Graduate Seminar
1-0-1, each.
Audit basis only

ISYE 8795. Colloquium in Cognitive Sciences
1-0-1.
Reading of research papers by leading cognitive scientists, attendance at their colloquia, and meeting with them to discuss research. Crosslisted with CS and PSYC 8795.

ISYE 8800. Special Topics in Industrial and Systems Engineering
3-0-3.

ISYE 8801. Special Topics in Operations Research
3-0-3.

ISYE 8841. Advanced Topics in Statistics
3-0-3. Prerequisites: MATH 4261 and ISYE 7441.
For Ph.D. students.

ISYE 8851. Topics in Manufacturing
3-0-3 Prerequisites: ISYE 6661 and ISYE 6761 or MATH 6761
Current topics in manufacturing including: manufacturing automation and controls, advanced planning systems,

heuristic scheduling techniques, stochastic models of manufacturing systems, advanced warehousing and materials handling.

ISYE 8852. Topics in Logistics
3-0-3. Prerequisite: ISYE 6661.
Current topics in logistics including: inventory control in supply chain design, stochastic vehicle routing, computational methods in logistics systems, location theory, and geographic information systems.

ISYE 8861. Advanced Topics in Stochastics
3-0-3. Prerequisites: ISYE 6762 or MATH 6762.
Coverage of advanced topics of interest that support research interests of students in the field.

ISYE 8862. Advanced Topics in Simulation
3-0-3. Prerequisites: ISYE 6762 or MATH 6762 and ISYE 6831.
Coverage of advanced topics of interest that support research interests of students in the field.

ISYE 8871. Advanced Topics in Linear and Discrete Optimization
3-0-3. Prerequisite: ISYE 6662.
Topics may vary with each offering and include subjects such as integer programming, combinatorics, graphs and networks, matching, matroids, polyhedral combinatorics, as well as others.

ISYE 8872. Advanced Topics in Nonlinear Optimization
3-0-3. Prerequisite: ISYE 6662.
Similar to ISYE 8871 but deals with subjects in nonlinear programming, interior-point methods, convexity, global optimization, etc. Topics may vary each semester.

ISYE 8890. Special Topics in Cognitive Science
3-0-3.

ISYE 8900. Special Problems in Industrial Engineering
Credit hours to be arranged.

ISYE 8901. Special Problems in Operations Research
Credit hours to be arranged.

ISYE 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding graduate teaching assistantships.

ISYE 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding graudate research assistantships.

ISYE 9000. Doctoral Thesis
Credit hours to be arranged.

School of Materials Science and Engineering

Established in 1985, School of Ceramic Engineering established in 1924.
Location: Bunger-Henry Building
Telephone: (404) 894-2888
Fax: (404) 894-9140
Website: www.mse.gatech.edu

Chair and Professor–Ashok Saxena; *Associate Chair and B. Mifflin Hood Professor*–Joe K. Cochran; *Regents' Professor*–Thomas Sanders; *Professor and Composites Education and Research Center Director*–W. Steven Johnson; *Regents' Professor and Mechanical Properties Research Laboratory Director*–David L. McDowell; *Professors*–Arun M. Gokhale, Miroslav Marek, William S. Rees, Michael D. Sacks, Christopher J. Summers, Rao Tummala, Laura J. Turbini, C. P. Wong; *Principal Research Engineer* –Kathryn V. Logan; *Professors Emeritus*–James F. Benzel, Helen Grenga, Robert F. Hochman; *Associate Professors*–W. Brent Carter, Rosario Gerhardt, Meilin Liu, Robert F. Speyer, Stuart R. Stock, Naresh N. Thadhani, Z.L. Wang; *Senior Research Scientist*–D. Norman Hill; *Assistant Professor*–Janet M. Hampikian; *Adjunct Professors*–Agaram S. Abhiraman, John Bradley, R. A. Young.

General Information

Recent surveys predicting the demand for engineering graduates suggest that the field of materials science and engineering can expect great potential for growth and advancement. Many more graduates will be needed. To meet this anticipated demand, the School of Materials Engineering was established in 1985. The name of the School was changed to the School of Materials Science and Engineering (MSE) in 1992 to reflect the broad range of the discipline.

In the past 10 years, there has been a growing awareness that many technological advances are being limited by the availability of materials. In many cases, materials cannot be usefully categorized into the traditional classes of metals, ceramics, or polymers. Examples include composites that are being introduced in airframes, automobile components, and sporting equipment; devices that are being fabricated from once exotic compounds for the electronics and computer industry; and ordered alloys used in jet engines. In response to rapidly evolving technology, traditional disciplines such as metallurgy, polymers, and ceramics are developing into more broadly based materials programs in which students are provided with an education emphasizing the fundamentals and principles of structure-property-processing-performance relationships independent of the class of material. There is a growing recognition that the needed discipline is "materials," and most of the leading institutions in the United States have adopted this approach. All engineers need education in materials, and a significant number of specialists in materials will be required to meet the needs of industry.

The School offers a Bachelor of Materials Science and Engineering. An undergraduate minor in Materials Science and Engineering is offered for non-MSE majors. Graduate degrees (M.S. and Ph.D.) are offered in Materials Science and Engineering and in Polymers. The various degree programs are described in the following sections.

Undergraduate Program

Bachelor of Science in Materials Engineering

The objective of this program is to graduate engineers at the baccalaureate level who are educated in the fundamentals of the structure-property-processing-performance relationships of materials and who can design, test, select, manufacture, and optimize components of all types of materials. Students follow a rigorous curriculum in basic science as well as the fundamental engineering disciplines. The goal of the materials science and engineering program is to produce graduates who are prepared to meet new technological challenges in which problems are solved by considering the relative merits of all classes of materials, and who are prepared for graduate work at leading universities.

Grade Requirements

In order to encourage students to explore subjects of personal or professional interest without jeopardizing their GPA, the Institute has a limited pass/fail option. The policy of the School of Materials Science and Engineering regarding the use of pass/fail hours for credit is as follows: No course specifically required by number by the Materials Science and Engineering curriculum may be taken on a pass/fail basis and used toward graduation, unless the course is offered only on that basis.

In addition to the Institute scholastic requirements, the School of Materials Science and Engineering requires that a grade of *C* or above be obtained in all MSE courses in order for them to be used as credit toward graduation.

A student whose final grade in an MSE course is *D* must repeat that course the next time it is offered, then must earn a *C* or better for it to be used as credit toward graduation. If the course is not offered again before the student's normal graduation date, the following paragraphs apply:

A student who has a single *D* deficiency in an MSE course that has not been offered again prior to their graduation term will be permitted one re-examination after the School has received the student's graduation term grades, but not later than 96 hours before commencement exercises, if the following conditions are met

a) the student did not receive any *F* grades in courses required for graduation for the graduation term

b) the *D* was not the result of poor lab performance

The re-examination will be graded *S* or *U* with a *C* or better performance required for an *S*. The previously assigned *D* will remain unchanged, but the director of Undergraduate Programs will approve its use toward graduation if the re-examination grade assigned is an *S*.

Bachelor of Science in Materials Engineering (Suggested Curriculum)

First Year - Fall Semester

Course Number/Name		*Hours*
MATH 1501	CALCULUS I	4
CHEM 1211	GENERAL CHEMISTRY	4
ENGL 1101	COMPOSITION I	3
CS 1301	COMPUTER SCIENCE I	3
MSE 1001	INTRO. TO ENGINEERING	1
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS		17

First Year - Spring Semester

Course Number/Name		*Hours*
MATH 1502	CALCULUS II	4
CHEM 1311	INORGANIC CHEMISTRY I	3
ENGL 1102	COMPOSITION II	3
PHYS 2211	PHYSICS I	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		17

Second Year - Fall Semester

Course Number/Name		*Hours*
MATH 2401	CALCULUS III	4
PHYS 2212	PHYSICS II	4
CHEM 2311	ORGANIC I	3
AE/ME 2751	INTRO. TO MECHANICS	3
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		17

Second Year - Spring Semester

Course Number/Name		*Hours*
MATH 2403	DIFF. EQUATIONS	4
CHEM 3411	PHYSICAL CHEMISTRY I	3
MSE 2001	PRINC. & APPS. OF ENG. MATERIALS	3
ECON 2100	ECONOMICS & POLICY	3
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		16

Third Year - Fall Semester

Course Number/Name		*Hours*
MSE 3001	CHEMICAL THERMO. MATERIALS	3
MSE 3005	MECHANICAL BEHAV. OF MATS.	3
MSE 3010	ANALYSIS OF MATERIALS	3
ECE 3710	CIRCUITS & ELECTRONICS	2
ISYE 3025	ENGINEERING ECONOMY	1
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS =		15

Third Year - Spring Semester

Course Number/Name		*Hours*
MSE 3002	STRUCTURAL TRANSFORMATIONS	3
MSE 3015	ELECT., OPTICAL & MAG. PROP.	3
MSE 3020	MATERIALS LAB	3
ECE 3741	INSTRUM. & ELECTRONICS LAB	1
ISYE/MATH 3770	STATISTICS & APPLICATIONS	3
TECHNICAL ELECTIVE		3
TOTAL SEMESTER HOURS		16

Fourth Year - Fall Semester

Course Number/Name		*Hours*
MSE 4002	CERAMIC MATERIALS	3
MSE 4004	MATERIALS IN ELECTRONIC APPS	3
MSE 4020	DESIGNING WITH MATERIALS I	1
MSE 4777	INTRO. TO POLYMERS	3
SOCIAL SCIENCE ELECTIVE		3
MSE ELECTIVE		3
TOTAL SEMESTER HOURS		16

Fourth Year - Spring Semester

Course Number/Name		*Hours*
MSE 4010	ENVIRONMENTAL DEGRAD.	3
MSE 4012	THERMAL PROPERTIES	3
MSE 4021	DESIGNING WITH MATERIALS II	2
MSE 4006	ENG'R ALLOYS	3
FREE ELECTIVE		3
TOTAL SEMESTER HOURS		14

TOTAL PROGRAM HOURS = 126 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Electives

Health and Performance Science Electives

This elective is satisfied by either HPS 1040 or 1061.

Humanities/Fine Arts Electives

This elective is satisfied by completing six hours from the lists on pages 33-34.

Social Sciences Electives

To satisfy the state requirements regarding course work on the history and constitutions of the U.S. and Georgia, students must complete one of the following courses: HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200.

Technical Elective

This elective is satisfied by any course on the following list. Other courses may be used to satisfy this requirement with the approval of the Materials Science and Engineering Undergraduate Curriculum Committee. Students should contact the director of Undergraduate Programs in the school if they want to make a substitution.

AE/ME/CE 1770 (2-3-3) Introduction to Engineering Graphics & Visualization
AE 4130 (3-0-3) Introduction to Finite Element Methods
AE 4375 (3-0-3) Fundamentals of Computer-aided Engineering & Design
BIOL 3420 (3-4-4) Introductory Microbiology
CE 3020 (2-3-3) Civil Engineering Materials
CHEM 2312 (3-0-3) Organic Chemistry II
CHEM 3111 (3-0-3) Inorganic Chemistry
CHEM 4452 (3-0-3) Chemistry of the Solid State
MATH 3720 (3-0-3) Statistics and Applications
MATH 4347 (3-0-3) Partial Differential Equations I
MATH 4640 (3-0-3) Numerical Analysis I
MATH/CS 4777 (3-0-3) Parallel Scientific Computing
ME 3340 (3-0-3) Fluid Mechanics
ME 4210 (3-0-3) Manufacturing Processes and Engineering
PHYS 3141 (3-0-3) Thermodynamics
PHYS 3143 (3-0-3) Quantum Mechanics I
TFE 3003 (2-3-3) Fundamentals of Transport in Textile Engineering

Materials Elective

This elective is satisfied by any MSE course(s) not specifically required by number in the curriculum.

Free Elective

Any course(s), with the exception of those listed on p. 33-34, may be used to satisfy the free elective. Students can strengthen their program of study with an appropriate selection of this elective. A student's academic advisor may be consulted in choosing the free elective.

Minor in Materials Science and Engineering

The School of Materials Science and Engineering offers an undergraduate minor in Materials Science and Engineering for non-MSE majors. The purpose of the minor is to broaden the materials background of non-materials science and engineering students and to introduce them to a materials approach to problem solving that is different from that provided by their major.

A requirement for earning a minor in Materials Science and Engineering is to complete 18 semester hours of MSE course work, of which 12 semester hours must be at the 3000 level or higher and all of which must be at the 2000 level or higher. Many students will be able to complete a considerable portion of the minor requirements by scheduling MSE courses as electives required by their major.

Non-MSE undergraduate majors are encouraged to participate in this program provided they have the appropriate prerequisites and approval of their home school academic advisor. To participate or for additional information, contact the director of Undergraduate Programs in the School of Materials Science and Engineering.

Graduate Programs

The field of materials is a vital component of the industrial economy because of its central contribution to the selection and use of materials in all engineering and scientific disciplines. Master's and doctoral degrees in materials science and engineering are offered. An excellent selection of undergraduate courses is also offered in preparation and support of graduate studies. Course offerings and research activities cover a range of subject areas in the broad field of materials. Subjects include physical metallurgy, mechanical properties, fracture mechanics, corrosion science and engineering, processing, phase equilibria, nondestructive testing, X-rays, phase transformations, glass science, electronic/technical ceramics, thin film semiconductors, dispersions and rheology, refractories, surface analysis, fiber science, polymerization reaction engineering, polymer process simulation, mechanical properties of polymers, and process-structure-property characterization of polymers. For a listing of approved polymer courses, also see the listings in the Schools of Chemical Engineering and Textile and Fiber Engineering. Research facilities in the School of Materials Science and Engineering are among the program's strong features.

Graduates find employment with manufacturing firms in light and heavy industry, in research laboratories of private firms and federal agencies, and in academic institutions. Several recent graduates have filled positions of high responsibility in these areas and have been instrumental in advancing the level of materials engineering practice in the United States. The materials engineering faculty participate in numerous multidisciplinary programs including manufacturing engineering, surface science technology, microelectronics, electronic packaging, polymers, and composites.

Mechanical Properties Research Laboratory

The Mechanical Properties Research Laboratory (MPRL) was established to encourage interdisciplinary research and educational opportunities in the field of the mechanical behavior of materials. Faculty members representing various academic disciplines at Georgia Tech, as well as staff members of the Georgia Tech Research Institute (GTRI), are involved in its activities. The research programs, which focus on the fracture and fatigue behavior of engineering materials, are interdisciplinary and based on a combined fracture mechanics-materials science point of view. Projects involving the behavior of metals, ceramics, polymers, and composites all fall within the scope of the laboratory. Graduate students participating in MPRL research usually enroll for the master's or doctoral degree in the traditional discipline of their choice. However, they pursue course work related to a broader understanding of materials and benefit from the association with other students and faculty in the interdisciplinary setting. Students with backgrounds in materials science, mechanical engineering, metallurgy, ceramics, chemistry, physics, or any other branch of engineering, are encouraged to apply. A graduate-level certificate program involving courses offered by materials, aerospace, and mechanical engineering is also available.

Composites Education and Research Center

The Composites Education and Research Center (CERC) is another interdisciplinary center similar to MPRL, providing students with the opportunity to participate in interdisciplinary course work and research projects in the area of composites. A graduate-level certificate program is available to students of materials science and engineering in composites, and several graduate courses are available.

The Master's Degree

The programs in MSE offer graduate work leading to the degrees of Master of Science in Materials Science and Engineering and Master of Science with a major in materials engineering. The student admitted for graduate work will normally have completed an undergraduate program in ceramics, metallurgy, polymers, or materials. However, students with undergraduate degrees or backgrounds in other fields (e.g., physics, chemistry, geology, and chemical, mechanical, nuclear, or geological engineering) may qualify by taking certain minimum prerequisites during the early part of their graduate studies. To assure a smooth transition into the graduate program, the student should select appropriate electives during his or her undergraduate studies.

Students in all M.S. programs must complete a core of graduate materials courses and prepare an individualized program of study for this degree in consultation with his or her graduate advisor. The proposed program must receive the approval of the graduate coordinator and the School chair. Thesis, non-thesis, and industrial internship options are available. The minimum credit hour requirements for the M.S. degree include 18 credit hours of courses and 12 credit hours of thesis research, or 30 credit hours of courses, or 24 hours of courses and 6 hours of project work conducted as part of an industrial internship. A total of 12 course hours must be in the major, and 12 course hours must be at the 6000 level or higher. A minimum GPA of 3.0 is required for graduation.

Master of Science in Polymers

The Master of Science degree in Polymers is offered through the schools of Materials, Chemical, and Textile and Fiber Engineering. The core course requirements for polymer degrees are the same in each school. This core is designed to provide a balanced treatment of the chemistry, physics, and engineering of polymeric materials. At the same time, the wide range of elective courses and research projects permits the students to develop an in-depth knowledge of a particular area of polymer science or engineering. This combination of breadth and depth of study is vital to the successful performance of polymer scientists and engineering graduates.

The Doctoral Degree

The Doctor of Philosophy degree is directed toward the goal of attaining proficiency in the pursuit of independent scholarly work. The degree comprises course work in the principles of materials generally, with emphasis on metallurgy, polymers, ceramics, or electronic materials. Additional requirements include specialized courses both in the area of the doctoral thesis and in one or two other areas, passing comprehensive examinations, and an independent research investigation.

Candidates for the doctoral degree are required to complete at least 18 credit hours of graduate-level course work beyond the M.S. degree, with a minimum GPA of 3.0, and pass the written and oral parts of the Ph.D. qualification examination. Each student must also earn nine credit hours in a coherent minor field, chosen in consultation with the advisor, and satisfy the School's core course requirements. Students should commence participation in the School's research programs early in their graduate careers.

Master of Science and Ph.D. in Bioengineering

The School of Materials Science and Engineering participates in the interdisciplinary program leading to a Master of Science and Ph.D. in Bioengineering. The program curriculum was developed by a broadly based faculty group with research activities in bioengineering and the life sciences. The students in the program are enrolled in a participating school, such as the School of Materials Science and Engineering, as their home department. The program is directed toward engineering graduates who wish to pursue a graduate degree in bioengineering rather than in a traditional field of engineering. For more details on the degree requirements for the M.S. and Ph.D. in bioengineering, see p. 132.

Minor in Materials Science and Engineering

For qualified Ph.D. students in other programs, a sequence of cross-listed courses in MSE (MSE 6795, 6796, and 6797) is available to introduce non-MSE students to advanced topics covering the broad field of materials. One or more of these courses along with other MSE courses can be used to satisfy the 9-credit-hour Institute minor requirement in other programs. Students wishing to participate in the MSE minor program must check with their advisor in their home school as to the appropriateness of the selected courses.

Financial Aid

A number of fellowships and research assistantships from outside sources and industry are available to provide financial assistance for qualified graduate students. In addition, a limited number of Presidential Fellowships, as well as teaching and research assistantships, are available from the Institute. Waiver of out-of-state tuition is possible for qualified students. Further information can be obtained by writing the director of the School of Materials Science and Engineering.

Multidisciplinary Programs

Materials Science and Engineering students may pursue a certificate within a designated multidisciplinary field in the College of Engineering. This can be facilitated with appropriate choice of electives. For a complete description of available programs, see p. 122.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab or recitation hours per week, and the semester hour credit earned for the completed course.

MATERIALS SCIENCE AND ENGINEERING

MSE 1001. Introduction to Engineering
1-0-1.
A general introduction to engineering. Topics include social, professional, and ethical issues, Tech's engineering curricula, contemporary issues, engineering design, teamwork, and a description of engineering skills.

MSE 1750. Introduction to Bioengineering
3-0-3.
An introduction to the field of bioengineering, including the application of engineering principles and methods to problems in biology and medicine, the integration of engineering with biology, and emerging industrial opportunities. Crosslisted with AE, CHE, ECE, and ME 1750.

MSE 2001. Principles and Applications of Engineering Materials
3-0-3. Prerequisites: PHYS 2211 and PHYS 2212 and CHEM 1211.
The structure-property-processing-performance relationships of engineering materials are described. Materials selection is treated as a part of engineering design.

MSE 3001. Chemical Thermodynamics of Materials
3-0-3. Prerequisite: MSE 2001 and MATH 2403 and CHEM 3411
Principles and applications of thermodynamics to materials science and engineering. Phase equilibria and the concepts necessary to interpret phase diagrams.

MSE 3002. Structural Transformations in Metallic, Ceramic, and Polymeric Systems
3-0-3. Prerequisite: MSE 3001.
Principles that govern the important structural transformations that occur in engineering materials.

MSE 3005. Mechanical Behavior of Materials
3-0-3. Prerequisite: MSE 2001 and (ME 2751 or AE 2751).
The correlation of monotonic and time-dependent mechanical properties with fundamental concepts of atomic bonding, crystalline state, microstructure, and micromechanics of materials.

MSE 3010. Crystallography and Diffraction Analysis of Materials
2-3-3. Prerequisites: CHEM 1211 and PHYS 2211 and PHYS 2212.
Principles and theory of crystallography and diffraction and diffraction analysis of materials, emphasizing x-ray diffraction, including electron diffraction and diffraction-based imaging.

MSE 3015. Electrical, Optical, and Magnetic Properties
3-0-3. Prerequisites: PHYS 2211 and PHYS 2212 and MSE 3010.
Band theory of solids, semiconductor physics, dielectric, optical, and magnetic phenomena. Superconductivity in various classes of materials.

MSE 3020. Materials Laboratory
1-6-3. Prerequisites: MSE 2001 and MSE 3010.
Fundamental principles of materials demonstrated in hands-on and demonstration experiments. Instruction on basic laboratory skills, safety, and proper technical report writing.

MSE 4002. Ceramic Materials: Properties, Processing, Applications
3-0-3. Prerequisite: MSE 3002.
Properties, processing, and applications of the industrially and technically important ceramic materials. Traditional and oxide ceramics in addition to glass and non-oxide ceramics.

MSE 4004. Materials in Electronic Applications
3-0-3. Prerequisite: MSE 3015.
Introduction to the fabrication requirements, property control, and structure-property-processing relationships in materials used in electronic, photonic, and magnetic applications.

MSE 4006. Processing and Applications of Engineering Alloys
3-0-3. Prerequisites: MSE 3002 and MSE 3010.
Influence of composition and processing variables on the microstructure and properties of nonferrous and ferrous alloys.

MSE 4010. Environmental Degradation
3-0-3. Prerequisites MSE 2001 and CHEM 3411
Theory of environmental degradation of metals, ceramics, and polymers. Emphasis on the scientific principles of degradation.

MSE 4012. Thermal Properties of Materials
3-0-3. Prerequisites: CHEM 1211 and PHYS 2211 and PHYS 2212 and MSE 2001.
Experimental methods of thermal property measurement, e.g. differential thermal analysis, thermogravimetric analysis, dilatometry/interferometry, thermal conductivity/diffusivity, and pyrometry.

MSE 4020. Designing with Materials I
1-0-1.
Introduction to principles of engineering design with emphasis on materials. Topics covered also include professional ethics and contemporary socio-political issues.

MSE 4021. Designing with Materials II
0-6-2. Prerequisite: MSE 4020.
A team-oriented, interdisciplinary course that emphasizes creativity in solving industrial-based problems. The design solutions developed must be demonstrated by feasability testing, which highlights this capstone design experience.

MSE 4310. Microscopy of Materials
3-0-3. Prerequisites: PHYS 2212 and MSE 3010.
Theory and operating knowledge of scanning electron microscopy, transmission electron microscopy, and stereology.

MSE 4315. Nondestructive Evaluation
3-0-3. Prerequisites: CHEM 1211 and PHYS 2211 and PHYS 2212.
Principles and theory of industrial nondestructive evaluation methods are covered. Emphasis is on testing the soundness and reliability of primary and secondary engineering structures.

MSE 4320. Electronic Packaging and Design
3-0-3. Prerequisite: MSE 2001.
Electronic packaging design, covering properties of materials, fabrication and assembly processes, thermal-mechanical considerations, practical concerns regarding interconnection and processing issues, and reliability assessment.

MSE 4325. Thin Film Materials Science
3-0-3. Prerequisite: MSE 2001.
Introduction to principal vapor deposition processes and vacuum technology. The fundamentals of the formation, characterization, and properties of a variety of thin films.

MSE 4775. Polymer Science and Engineering I: Formation and Properties
3-0-3. Prerequisite(s): CHEM 2312 and CHEM 3411.
An introduction to the chemistry, structure, and formation of polymers, physical states and transitions, physical and mechanical properties of polymer fluids and solids. Crosslisted with CHE, CHEM, ME, and TFE 4775.

MSE 4776. Polymer Science and Engineering II: Analysis, Processing, and Laboratory
1-6-3. Prerequisites: CHE 4775 or CHEM 4775 or ME 4775 or TFE 4775.
Polymer fabrication processes and methods of characterization and identification of polymers are presented. Experiments in polymerization, processing, and property evaluation of polymers. Crosslisted with CHE, CHEM, ME, and TFE 4776.

MSE 4777. Introduction to Polymer Science and Engineering
3-0-3. Prerequisite: MATH 2403.
An introduction to the structure and formation of polymers, physical states and transitions, physical and mechanical properties of polymer fluids and solids, and processing of polymers. Crosslisted with CHE, ME, and TFE 4777.

MSE 4791. Mechanical Behavior of Composites
3-0-3. Prerequisites: AE 2751 or ME 2751.
Introduction to properties and structures of common matrix and reinforcing materials, mechanics of fiber-reinforced composites, lamina and laminate analysis, and mechanical performance. Crosslisted with AE, CEE, CHE, ME, and TFE 4791.

MSE 4793. Composite Materials and Processing
3-0-3. Prerequisites: CHEM 1211 and PHYS 2211 and PHYS 2212.
Basic principles of selecting component materials and manufacturing composites are presented. Polymeric, metallic, and ceramic systems are considered. Crosslisted with AE, CEE, CHE, ME, and TFE 4793.

MSE 4794. Composite Materials and Manufacturing
2-3-3.
Basic principles of selection and design of composite materials and their manufacturing and testing. Cost factors. Laboratory exercises on manufacturing and tests. Crosslisted with AE, CEE, CHE, ME, and TFE 4794.

MSE 4801, -2, -3. Special Topics
Credit hours equal last digit in the course number.

MSE 4901,-2. Special Problems
Credit hours to be arranged.

MSE 4951. Independent Research I
0-3-1.
The student selects an advisor and defines an area of research. MSE 4952 must be completed for this course to be used for elective credit.

MSE 4952. Independent Research II
0-6-2. Prerequisite: MSE 4951.
The student completes an experimental plan coordinating with the research advisor. The laboratory research will be completed and a final report submitted.

MSE 6010. Fundamentals of Functional Materials
3-0-3.
This course focuses on the effects of defects on physical properties; charge/mass transport; semiconductors, heterojunctions, electrical and magnetic polarization, interaction processes between various physical properties; electrical characterization techniques.

MSE 6105. Diffraction Studies
2-3-3.
Principles and theory of crystallography and diffraction analysis of materials are covered, emphasizing x-ray diffraction, including electron diffraction and diffraction-based imaging. Reciprocal lattice concepts are emphasized.

MSE 6110. Transmission Electron Microscopy
3-0-3. Prerequisite: MSE 3010.
Introduction to the kinematical electron scattering theory, optics in TEM, diffraction contrast imaging of defects, dynamical electron diffraction effects; and chemical microanalysis using EDS.

MSE 6120. Quantitative Characterization of Microstructures
2-3-3.
Application of statistically unbiased methods for estimating geometrical attributes of microstructures and non-planar fracture surfaces from plane sections and projections, digital image analysis, and computer simulations of microstructures.

MSE 6130. Surface Analysis
3-0-3.
Introduction to vacuum science and technology; structure of solid surfaces; electron and ion energy analyzers, electron spectroscopies (e.g., AES and XPS); ion-based techniques (e.g., SIMS and RBS); depth profiling; ion channeling.

MSE 6210. Defects
3-0-3.
Emphasis on the origin and character of point, line, and surface defects in crystalline materials and their influence on mechanical, chemical, magnetic, optical, and electronic properties.

MSE 6310. Thermodynamics and Kinetics of Transformations
3-0-3. Prerequisite: MSE 3001.
Classical thermodynamics and phase equlibria with applications to chemical reactions, control of phase transformations via reduction of chemical-free energy, strain energy, and interfacial energy.

MSE 6410. Fine Particle Technology
3-0-3. Prerequisite: MSE 3002.
Theory of solid/liquid surface chemistry, particle/particle interactions in liquids, rheology of suspensions, and gas adsorption as related to surface area and pore size distributions.

MSE 6510. Polymers for Electronic and Photonic Applications I
3-0-3.
Review of fundamentals and principles of polymers used in electronics and photonics; relationships between the advances of semiconductor technology and the importance of polymers and their applications.

MSE 6610. Biomaterials
2-0-2.
The course will emphasize the interaction between the human body environment and synthetic materials. Materials

for both medical implants and dental restoration and appliances will be covered.

MSE 6620. Advanced Corrosion
2-3-3. Prerequisite: MSE 4010.
The emphasis will be on electrochemical corrosion and dry oxidation of metals and alloys. In the laboratory the student will be introduced to the methodology of corrosion testing.

MSE 6751. Physical Chemistry of Polymer Solutions
3-0-3. Prerequisites: (CHE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or TFE 4775) or (ME 4777 or MSE 4777 or TFE 4777).
Study of polymer solutions, polymer miscibility, adsorption, sorptions, plasticization, molecular weights, molecular weight distribution, and interfacial phenomena using thermodynamics and statistical mechanics. Crosslisted with CHEM, CHE, and TFE 6751.

MSE 6752. Polymer Characterization
3-3-4. Prerequisites: (CHE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or TFE 4775) or (ME 4777 or MSE 4777 or TFE 4777).
This course introduces the student to surface, near-surface , and structural methods of polymer characterization. Specialized techniques critical to physical structure are emphasized. Crosslisted with CHEM, CHE, and TFE 6752.

MSE 6755. Theoretical Chemistry of Polymers
3-0-3. Prerequisites: CHEM 6471 and (CHE 6751 or CHEM 6751 or MSE 6751 or TFE 6751).
Thermodynamics and microscopic dynamics of polymers. Fundamental concepts, including scaling concepts, governing anisotropy of polarizability, phase transitions, morphology, time-dependent correlations, etc. are discussed. Crosslisted with CHEM and TFE 6755.

MSE 6759. Materials in Environmentally Conscious Design and Manufacturing
3-0-3.
Covers the environmental impact of materials choices and quantitative measure of life-cycle assessment and environmental burden. The Natural Step philosophy will be used as a model for the overall approach. Crosslisted with ME and TFE 6759.

MSE 6768. Polymer Structure, Physical Properties, and Characterization
3-0-3. Prerequisites: CHE 4776 or CHEM 4776 or ME 4776 or MSE 4776 or TFE 4776.
Formulations and analysis of molecular and phenomenological models of elastic and viscoelastic behavior, development and description of structure, and fundamental aspects of structure-property relations. Crosslisted with TFE, CHE, and ME 6768.

MSE 6795. Mathematical, Statistical, and Computational Techniques in Materials Science
3-0-3.
Fundamental physical, analytical, and mathematical techniques encountered in materials engineering including stress and strain, crystallographic and orientation transformations, X-ray, TEM, and solid-state concepts are emphasized.

MSE 6796. Structure-Property Relationships in Materials
3-0-3.
Introduction to the multi-scale structure effects on material properties. Course will prepare students for future in-depth courses. Crosslisted with TFE and ME 6796.

MSE 6797. Thermodynamics and Kinetics of Microstructural Evolution
3-0-3.
The reduction of chemical free, strain, and interfacial energies control the kinetics of diffusional transformations. These factors are explored from the viewpoint of processing and stability of microstructure during service. Crosslisted with TFE and ME 6797.

MSE 7000. Master's Thesis
Credit hours to be arranged.

MSE 7010. Electroceramics
3-0-3. Prerequisite: MSE 6010..
Defects chemistry; electrochemical and electrophysical behavior of metallic/semiconducting ceramics, dielectrics, and ferrites; device applications of various electronic ceramics.

MSE 7110. Advanced Transmission Electron Microscopy
3-0-3. Prerequisite: MSE 6110.
Introduction to theory, techniques, and applications of high-resolution transmission electron microscopy (HRTEM) in materials research.

MSE 7140. Impedance and Dielectric Spectroscopy
3-0-3. Prerequisite: MSE 6010.
The basic theory of how current, voltage, and phase angle measurements over a wide frequency range (typically mHz-MHz)can provide information about microstructural features at all length scales.

MSE 7210. Dislocation and Deformation Mechanics
3-0-3. Prerequisite: MSE 6210.
Emphasis on interactions of dislocations with other defects, dislocation dynamics, and their correlation with mechanical properties under different rates of loading.

MSE 7420. Solidification Processing
3-0-3. Prerequisite: MSE 6310.
Fundamentals of thermodynamics, kinetics, mass transport, and physical materials are applied to the development of microstructure during solidification.

MSE 7510. Polymers for Electronic and Photonic Applications II
3-0-3. Prerequisite: MSE 6510.
Review of fundamentals and principles of polymers used in electronics and photonics. The relationship between the recent advances of semiconductor technology and the importance of polymers will be discussed.

MSE 7771. Mechanics of Polymer Solids and Fluids
3-0-3. Prerequisites: MSE 4772 and MSE 6768.
Continuum mechanics of solids and fluids; mechanics of deformation of anisotropic polymers; yield, breaking, and fatigue; non-Newtonian vioscous and viscoelastic behavior of polymer fluids. Crosslisted with CHE, ME, and TFE 7771.

MSE 7772. Fundamentals of Fracture Mechanics
3-0-3. Prerequisites: ME 3201 or MSE 3005.
Advanced study of failure of structural materials under load, mechanics of fracture, and microscopic and macroscopic aspects of the fracture of engineering materials. Crosslisted with AE, CEE, CHE, and ME 7772.

MSE 7773. Advanced Fracture Mechanics
3-0-3. Prerequisite(s): AE 7772 or CEE 7772 or CHE 7772 or ME 7772 or MSE 7772.
Nonlinear fracture mechanics including elastic-plastic and time-dependent fracture, advanced test methods, J-integral theory, and extensions. Crosslisted with AE, CEE, CHE, and ME 7773.

MSE 7774. Fatigue of Materials and Structures
3-0-3. Prerequisites: AE 7772 or CEE 7772 or CHE 7772 or ME 7772 or MSE 7772.
Mechanical and microstructural aspects of nucleation and growth of cracks under cyclic loading conditions, notch effects, cumulative damage, multiaxial loading and fatigue crack propagation. Crosslisted with AE, CEE, CHE, and ME 7774.

MSE 7775. Topics in Fracture and Fatigue of Metallic and Composite Structures
3-0-3. Prerequisites: AE 2751 or ME 2751.
Brittle and Ductile failure criteria. Failure prediction in composite structures. Free-edge and internal delamination. Anisotropic cracks. Fatigue behavior of composites and comparison with metal fatigue. Crosslisted with AE, CHE, and ME 7775.

MSE 7791. Damage, Failure, and Durability of Composite Material
3-0-3. Prerequisites: AE 4791 or CEE 4791 or CHE 4791 or ME 4791 or MSE 4791.
Analysis and failure of fiber-reinforced composite material systems. Mechanisms of toughening, multiple cracking mechanisms. Failure in woven fabric, braided, and special geometry composites. Crosslisted with AE, CHE, CEE, ME, and TFE 7791.

MSE 7792. Advanced Mechanics of Composites
3-0-3. Prerequisites: AE 4791 or CEE 4791 or CHE 4791 or ME 4791 or MSE 4791 or TFE 4791.
Anisotropic elasticity, hygrothermal behavior, stress analysis of laminated composites including 3-D effects, stress concentrations, free-edge effects, thick laminates, adhesive and mechanical connections, fracture of composites. Crosslisted with AE, CHE, CEE, ME, and TFE 7792.

MSE 7793. Manufacturing of Composites
3-0-3. Prerequisites: AE 4793 or CEE 4793 or CHE 4793 or ME 4793 or MSE 4793 or TFE 4793.
Major manufacturing techniques for metal, ceramic, and polymer composites. Modeling of processes with emphasis on fundamental mechanisms and effects. Crosslisted with AE, CHE, CEE, ME, and TFE 7793.

MSE 8001. Seminar
1-0-1.
The latest advances in research and development will be presented by the enrolled students from articles in recent issues of recognized periodicals.

MSE 8801. Special Topics
1-0-1.
Special topic offerings of current interest not included in regular courses.

MSE 8802. Special Topics
2-0-2.
Special topic offerings of current interest not included in regular courses.

MSE 8803. Special Topics
3-0-3.
Special topic offerings of current interest not included in regular courses.

MSE 8901,-2,-3. Special Problems
Credit hours to be arranged.
Lectures, laboratory, and library work on special topics of current interest in materials suitable for a master's degree candidate.

MSE 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding teaching assistantships.

MSE 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding a research assistantship.

MSE 9000. Doctoral Thesis
Credit hours to be arranged.

School of Mechanical Engineering

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Systems–Jerry H. Ginsberg; *Carter N. Paden Distinguished Chair in Metals Processing*–David L. McDowell; *Parker H. Petit Distinguished Chair for Engineering in Medicine*–Robert M. Nerem; *Rae and Frank H. Neely Distinguished Chair in Mechanical Engineering*–Peter H. Rogers; *Fuller E. Callaway Professor*–Weston M. Stacey Jr.; *Eugene C. Gwaltney Jr. Chair in Manufacturing Systems*–Ward O. Winer; *David S. Lewis Chair in Aerospace Engineering*–Ben T. Zinn; *Regents' Professors*–David N. Ku, Amyn S. Teja, Ajit P. Yoganathan; *Professors*–Yves H. Berthelot, Wayne J. Book, Jonathan S. Colton, Prateen V. Desai, Robert E. Fulton, Ari Glezer, Itzhak Green, James G. Hartley, Nolan E. Hertel, Jacek Jarzynski, W. Steven Johnson, W. Jack Lackey, Gunter H. Meyer, Farrokh Mistree, G. Paul Neitzel, Richard F. Salant; *Associate Professors*–Bert Bras, Ye-Hwa Chen, J. Narl Davidson, Aldo A. Ferri, S. Mostafa Ghiaasiaan, Iwona M. Jasiuk, Sheldon M. Jeter, Prasanna V. Kadaba, Thomas R. Kurfess, Kok-Meng Lee, Steven Y. Liang, Harvey Lipkin, John G. Papastavridis, Jianmin Qu, Farzad Rahnema, David W. Rosen, Nader Sadegh, Samuel V. Shelton, Marc K. Smith, Jeffrey L. Streator, Charles Ume, John D. Valentine, Timothy M. Wick, Cheng Zhu; *Assistant Professors*–Daniel F. Baldwin, Robert S. Cargill II, Kenneth A. Cunefare, Imme Ebert-Uphoff, Andrés J. García, Robert E. Guldberg, Damir Juric, Marc E. Levenston, Christopher S. Lynch, Shreyes N. Melkote, Richard W. Neu, William E. Singhose, Suresh K. Sitaraman, C.-K. Chris Wang, Minami Yoda, Min Zhou.

General Information

Mechanical engineering (ME) was the first academic program established at Georgia Tech. On September 20, 1985, the School of Mechanical Engineering celebrated its centennial by assuming the name of one of its most distinguished alumni, Atlanta businessman and philanthropist George W. Woodruff (Class of 1917). Today, the Woodruff School offers studies not only in mechanical engineering, but also in the related fields of nuclear and radiological engineering and health physics.

Mechanical engineering traditionally deals with diverse engineering problems. Because of its general nature, mechanical engineering encourages a number of multidisciplinary activities to be conveniently organized within it. Mechanical engineering embraces the generation, conversion, transmission, and utilization of thermal and mechanical energy; the design and production of tools and machines and their products; the consideration of fundamental characteristics of materials as applied to design; and the synthesis and analysis of mechanical, thermal, and fluid systems, including the automation of such systems. Design, production, manufacture, operation, administration, economics, and research are functional aspects of mechanical engineering.

The Bachelor of Nuclear and Radiological Engineering (B.N.R.E.) degree provides students with the fundamentals of nuclear and radiological engineering. The student may use technical electives to obtain an emphasis in one area. This degree program should provide graduates who have a bachelor's degree with professional flexibility to work in either nuclear power generation, radiation protection, or in nonpower professions that use nuclear and radiation technology. In addition, the B.N.R.E. is excellent preparation for pursuing graduate degrees in nuclear or radiological engineering and in health or medical physics.

Nuclear engineering is the branch of engineering directly concerned with the release, control, utilization, and environmental impact of energy from nuclear fission and fusion sources. Today, the diversity of nuclear energy allows a variety of applications, from powering space exploration to the large-scale generation of electricity. With a growing concern about the environmental effect of burning fossil fuels and the potential of advanced nuclear reactor designs, nuclear power should continue to be one of the major ways to generate electricity.

Radiological engineering is a discipline that combines a knowledge of radiation physics and engineering fundamentals to design and analyze radiation sources and detection instruments, to measure dosage, to design protective shielding, and to handle radioactive materials. Increasing uses of radiation are found in agriculture, medicine and health care, manufacturing, environmental protection, mineral exploration, airport security, regulatory agencies, and scientific research.

Health physics is an applied science concerned with the protection of people and the environment from the hazards of radiation and chemical pollutants. Health physicists develop a sound philosophy of radiation protection, apply these principles on the job in an industrial or medical setting or with a regulatory agency, and devise new methods and instrumentation for the protection of both individual workers and the general public.

School Facilities

The Woodruff School of Mechanical Engineering has many types of specialized instruments and equipment associated with laboratories for the study of acoustics, bioengineering, tribology and rheology, material processing, combustion, energetics, heat transfer, vibration and thermal stress, computer-aided design, automatic control, machinery, mechatronics, manufacturing automation, noise, robotics, and other areas. The School is housed in a seven-building classroom/ research complex. Part of this complex is a modern classroom/seminar conference building that serves the entire Institute. All facilities are connected to the campus fiber optics network and the Internet. The machine and instrumentation shops, supported by a full-time staff of technicians, enhance the School's research activities. The facilities available for the nuclear engineering program include the Neely Research Center, which houses both light-water and graphite subcritical assemblies, over 120,000 curies of cobalt-60, a californium-252 source for use in neutron dosimetry studies, hot cells for handling radioactive materials, a complete nuclear instrumentation laboratory, nuclear radiography equipment, radiochemical laboratories, and facilities for analyzing environmental samples by nuclear techniques.

Undergraduate Program

The undergraduate curriculum in mechanical engineering covers the fundamental aspects of the field, emphasizes basic principles, and educates the student in the use of these principles to reach optimal design solutions for engineering problems. Specific design subject matter and materials are also drawn from engineering activities such as lunar vehicles and biomechanical systems, as well as from the more traditional areas. Emphasis in the freshman and sophomore years is on mathematics, chemistry, physics, introductory mechanics, and engineering graphics with an introduction to design. Students must pass all required mathematics courses with a grade of *C* or better. The junior and senior years are devoted to the mechanics of materials and materials, applied mechanics, heat transfer, fluid mechanics, systems and controls, design, manufacturing, and the application of fundamentals to the diverse problems of mechanical engineering. The curriculum stresses laboratory work and design projects. Computer skills, as demonstrated by the successful completion of ME 2016, are a prerequisite for all junior- and senior-level courses. Satisfactory completion of the curriculum leads to the degree of Bachelor of Science in Mechanical Engineering.

The undergraduate curriculum in nuclear and radiological engineering is structured to meet the needs of both the student who contemplates employment immediately after graduation and the student planning to pursue graduate study. It provides maximum flexibility in the form of options for each student to develop his or her unique interests and capabilities. The core curriculum covers the basic principles of nuclear engineering, nuclear reactor core design, reactor systems engineering, nuclear power economics, reactor operations, radiation sources and detection instruments, radiation transport, radiation protection, criticality safety, regulatory requirements, radioactive materials management, and health physics. In addition to the Institute's academic requirements for graduation with a bachelor's degree, the average aggregate grade point ratio in nuclear engineering and health physics courses taken toward the BNRE degree must be 2.0 or higher. Furthermore, the average aggregate grade point average for courses taken in engineering thermodynamics and transport phenomena must be 2.0 or higher. Students must pass all required mathematics courses with a grade of *C* or higher. Only the highest grade received in any repeated course will be used in calculating quality points for these supplemental criteria.

Mechanical Engineering Electives

Humanities, Social Sciences, and Modern Languages

A total of 12 credit hours of humanities and 12 credit hours of social sciences are required. See pages 33-34 for a list of acceptable courses. Students should consult with their academic advisor for course sequences that satisfy the depth requirement.

The humanities and social sciences courses taken must include six credit hours at the 3000 or 4000 level. This requirement can be satisfied with two humanities courses, two social sciences courses, or one course in each area. Included in the 12 hours of humanities electives is a 3-hour course in ethics selected from: PST 3105 (Theories of Ethics); PST 3109 (Ethics for the Technical Professions), PST 4326 (Environmental Ethics), and INTA 2030 (Ethics & International Affairs). ENG 1101 and 1102 (English Composition 1 and 2) satisfy 6 hours of the humanities electives.

The social science elective may be satisfied by ECON 2100 (Economic Analysis and Policy Problems). To satisfy the state requirements regarding course work on the history and constitutions of the U.S. and Georgia, students must complete one of the following courses: HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200. Any of these courses go toward satisfying the social science elective.

Health & Performance Science Electives

There are two choices to satisfy the health and performance science electives. Students must choose from HPS 1040 (Health Concepts and Strategies) and HPS 1061 (Fitness Concepts: A Wellness Approach).

Free Electives

There are no free electives *required* for graduation. If ROTC is chosen, then it will count as a free elective.

Technical Electives

Technical electives must be chosen from the list of acceptable electives in the *Mechanical Engineering Undergraduate Handbook*. This list includes all 4000-level ME courses as well as selected courses in other fields. ME courses at the 6000 level may also be scheduled, provided the student has a grade point average of 3.0 or higher and prior consent is obtained from both the instructor and the associate chair for Graduate Studies.

A student completing his or her junior year with a grade point average of 2.5 or higher may elect one technical elective from the Special Problems course, ME 4901.

Science Electives

The science elective may be satisfied by one four-hour course from the following list: CHEM 1311 (Inorganic Chemistry) and CHEM 1312 (Inorganic Chemistry Lab) taken together, or one of the following: BIOL 1501 (Biological Principles), BIOL 1520 (Introduction to Organismal Biology), EAS 1600 (Introduction to Environmental Science), EAS 1601 (Habitable Planet), and PHYS 3366 (Computational Physics).

Nuclear Engineering Electives

Humanities, Social Sciences, and Modern Languages

A total of 12 credit hours of humanities and 12 credit hours of social sciences are required. See pages 33-34 for a list of acceptable courses. Students should consult with their academic advisor for course sequences that satisfy the depth requirement.

The humanities and social sciences courses taken must include 6 credit hours at the 3000 or 4000 level. This requirement can be satisfied with 2 humanities courses, 2 social sciences courses, or 1 course in each area. Included in the 12 hours of humanities electives is a 3-hour course in ethics selected from: PST 3105 (Theories of Ethics); PST 3109 (Ethics for the Technical Professions), PST 4326 (Environmental Ethics), and INTA 2030 (Ethics and International Affairs). ENG 1101 and 1102 (English Composition 1 and 2) satisfy 6 hours of the humanities electives.

The social science elective may be satisfied by ECON 2100 (Economic Analysis and Policy Problems). To satisfy the state requirements regarding course work on the history and constitutions of the U.S. and Georgia, students must complete one of the following courses: HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200. Any of these courses go toward satisfying the social science elective.

Health & Performance Science Electives

There are two choices to satisfy the health and performance science electives. Students must choose from HPS 1040 (Health Concepts and Strategies) and HPS 1061 (Fitness Concepts: A Wellness Approach).

Science Elective

There are no science electives required.

Free Electives

There are no free electives *required* for graduation. If ROTC is chosen, then it will count as a free elective.

Technical Electives

Technical electives must be chosen from the list of acceptable electives in the *Nuclear and Radiological Engineering Undergraduate Handbook*. Nine hours are required to satisfy the technical electives. NE courses at the 6000 level may also be scheduled, provided the student has a grade point average of 3.0 or higher and prior consent is obtained from both the instructor and the associate chair for Graduate Studies.

A student completing his or her junior year with a grade point average of 2.5 or higher may elect one technical elective from the Special Problems course, 4901.

Bachelor of Science in Mechanical Engineering (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
MATH 1501	CALCULUS I	4
ENGL 1101	COMPOSITION I	3
CHEM 1211	GENERAL CHEMISTRY	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or	INTA 1200	3
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS		16

First Year - Spring Semester

Course Number/Name		*Hours*
MATH 1502	CALCULUS II	4
ENGL 1102	COMPOSITION II	3
PHYS 2211	PHYSICS I	4
CS 1301	COMPUTER SCIENCE I	3
ME/CE 1770	ENGINEERING GRAPHICS	3
TOTAL SEMESTER HOURS		17

Second Year - Fall Semester

Course Number/Name		*Hours*
MATH 2401	CALCULUS III	4
PHYS 2212	PHYSICS II	4
ME 2751	INTRO. TO MECHANICS	3
ME 2016	COMPUTER TECHNIQUES	3
ME 2110	CREATIVE DECISIONS AND DESIGN	3
TOTAL SEMESTER HOURS		17

Second Year - Spring Semester

Course Number/Name		*Hours*
MATH 2403	DIFF. EQUATIONS	4
ME 2202	DYNAMICS OF RIGID BODIES	3
MSE 2001	PRINC. & APPS OF ENG. MATERIALS	3
LAB SCIENCE ELECTIVE (CHEM 1311 & 1312, BIOL 1510,	1520, EAS 1600, or PHYS 3366)	4
ECE 3710	CIRCUITS, ELECTRONICS	2
TOTAL SEMESTER HOURS		16

Third Year - Fall Semester

Course Number/Name		*Hours*
ME 3015	SYS. DYNAMICS & CONTROL	4
ME 3322	THERMODYNAMICS	3
ME 3340	FLUID MECHANICS	3
ME 3201	MECHANICS OF MATERIALS	3
ECON 2100	ECONOMICS & POLICY	3
ECE 3741	INSTRU. & ELECTRONICS LAB	1
TOTAL SEMESTER HOURS		17

Third Year - Spring Semester

Course Number/Name		*Hours*
ME 3056	EXP. METHODS LAB	2
ME 3345	HEAT TRANSFER	3
ME 3180	MACHINE DESIGN	3
ECE 3301	ENERGY CONVERSION	2
ISYE 3025	ENGINEERING ECONOMY	1
ISYE/MATH 3770	STATISTICS & APPLICATIONS	3
TOTAL SEMESTER HOURS		14

Fourth Year - Fall Semester

Course Number/Name		*Hours*
ME 4053	ME SYSTEMS LAB	2
ME 4315	ENERGY SYS. ANALYSIS & DESIGN	3
ME 4210	MFG. PROCESS & ENGINEERING	3
HUMANITIES ELECTIVE		3
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		14

Fourth Year - Spring Semester

Course Number/Name		*Hours*
ME 4055	EXPER. ENGR LAB	1
ME 4182	CAPSTONE DESIGN	3
HUMANITIES ELECTIVE (ETHICS = PST 3105 or 3109 or 4326 or INTA 2030)		3
TECHNICAL ELECTIVES		6
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		16

TOTAL PROGRAM HOURS = 125 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Bachelor of Science in Nuclear and Radiological Engineering (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
MATH 1501	CALCULUS I	4
ENGL 1101	COMPOSITION I	3
CHEM 1211	GENERAL CHEMISTRY	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS		16

First Year - Spring Semester

Course Number/Name		*Hours*
MATH 1502	CALCULUS II	4
ENGL 1102	COMPOSITION II	3
PHYS 2211	PHYSICS I	4
CS 1301	COMPUTER SCIENCE I	3
NRE 2110	INTRO. TO NRE	2
TOTAL SEMESTER HOURS		16

Second Year - Fall Semester

Course Number/Name		*Hours*
MATH 2401	CALCULUS III	4
PHYS 2212	PHYSICS II	4
ME 2751	INTRO. TO MECHANICS	3
ECE 3710	CIRCUITS, ELECTRONICS	2
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		16

Second Year - Spring Semester

Course Number/Name		*Hours*
MATH 2403	DIFF EQUATIONS	4
PHYS 2133	INTRO. TO MODERN PHYSICS	3
MSE 2001	PRINC. & APPS. OF ENG. MATERIALS	3
ECON 2100	ECONOMICS & POLICY	3
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		16

Third Year - Fall Semester

Course Number/Name		*Hours*
NRE 3301	RADIATION PHYSICS	3
ME 3322	THERMODYNAMICS	3
ME 3340	FLUID MECHANICS	3
ECE 3741	INSTRU. & ELECTRONICS LAB	1
ISYE 3025	ENGINEERING. ECONOMY	1
MATH 4581	MATH METHODS IN ENGINEERING	3
TOTAL SEMESTER HOURS		14

Third Year - Spring Semester

Course Number/Name		*Hours*
ECE 3301	ENERGY CONVERSION	2
NRE 3316	RADIATION PROTECTION	3
NRE 3111	RADIATION DETECTION	2
HUMANITIES ELECTIVE (ETHICS = PST 3105 or 3109 or 4326 or INTA 2030)		3
ME 3345	HEAT TRANSFER	3
ME 3201	MECHANICS OF MATERIALS	3
TOTAL SEMESTER HOURS		16

Fourth Year - Fall Semester

Course Number/Name		*Hours*
NRE 4214	REACTOR ENGINEERING	3
NRE 4316	RADIATION SOURCES/RADIOACTIVE MATERIALS MANAGEMENT	3
NRE 4204	NUCLEAR REACTOR PHYSICS	4
SOCIAL SCIENCE ELECTIVE		3
TECHNICAL ELECTIVE		3
TOTAL SEMESTER HOURS		16

Fourth Year - Spring Semester

Course Number/Name		*Hours*
NRE 4326	RADIATION APPLICATIONS	3
NRE 4232	NRE DESIGN	4
TECHNICAL ELECTIVES		6
NRE 4206	RADIATION PHYSICS LAB	2
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 123 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Graduate Programs

The graduate program in mechanical engineering offers advanced study and research in the areas of acoustics and noise control, applied mechanics, automatic controls, bioengineering, combustion, computer integrated and controlled manufacturing systems, dynamics and vibration, energy engineering, engineering and systems design, environmental quality control, fluid mechanics, heat transfer, lubrication, computer-aided design, computer-aided manufacturing, manufacturing engineering, materials processing, materials science, mechanisms (synthesis and analysis), microelectromechanical systems (MEMS), mechatronics, robotics, vehicle propulsion, thermal systems, thermodynamics, transport processes, and tribology.

These graduate programs lead to the degrees of Master of Science in Mechanical Engineering, Master of Science, and Doctor of Philosophy for qualified graduates having backgrounds in engineering, mechanics, mathematics, the physical sciences, or the biological sciences. The master's degree requires a minimum of 30 approved credit hours. Students may elect to earn 9 of these hours by writing a thesis, or they may earn all credit toward the degree through course work. Six hours of credit for a graduate course taken as an undergraduate at Georgia Tech and used for credit toward the B.S.M.E. may be included in the M.S. program of study if the student graduated with an undergraduate grade point average of at least 3.5. Students must earn a graduate grade point average of at least 3.0 and satisfy all remaining requirements to be certified for the master's degree. Candidates for the Doctor of Philosophy degree must earn a graduate grade point average of at least 3.3. Students may obtain additional information about the programs by calling the School at (404) 894-3204 and requesting the *Mechanical Engineering Graduate Handbook* or viewing the web page at www.me.gatech.edu/academics/GraduateInfo.htm for the complete guide. Every student enrolled must consult this source of information with respect to special rules and degree requirements.

The graduate program in nuclear engineering leads to the degrees of Master of Science in Nuclear Engineering, Master of Science, and Doctor of Philosophy. In nuclear engineering, students with a bachelor's degree in engineering pursue the Master of Science in Nuclear Engineering degree, while students with a Bachelor of Science degree enroll for the Master of Science degree. Depending on the career objectives of the student, the School may encourage a thesis as part of the Master of Science program. Nuclear engineering students must earn a graduate grade point average of at least 3.0 and satisfy all remaining requirements to be certified for the master's degree or the Doctor of Philosophy degree. The doctoral program is designed with great latitude to capitalize on variations in experience and interests of individual students. Candidates for the Doctor of Philosophy degree must earn a graduate grade point average of at least 3.3. The School encourages its students to enroll in nuclear engineering courses and in courses related to their subject areas offered by other schools.

The graduate program in health physics leads to the degree of Master of Science in Health Physics (M.S.H.P.). The program focuses on radiological and environmental protection. In addition to the traditional on-campus M.S. program, a video-based program leading to the M.S.H.P. degree is also offered to accommodate the needs of professionals in the field. A large number of health physics practitioners in government and industry participate in the video-based program.

Three hours of credit for a graduate course taken as an undergraduate at Georgia Tech and used for credit toward an undergraduate degree in science or engineering may also be included in the M.S. health physics program of study if the student graduated with an undergraduate grade point average of at least 3.5. Health physics students must earn a graduate grade point average of at least 3.0 and satisfy all remaining requirements to be certified for the master's degree.

Video-Based Master's Programs

The Woodruff School offers working professionals the opportunity to enroll in many of its graduate courses through video technologies. Qualified individuals may complete the requirements for the master's degrees in mechanical engineering and health physics by utilizing the video-based delivery system. See page 36, "Video-Based Instruction."

Beginning in fall 1999, the Woodruff School will offer selected courses on the Internet.

Dual Degree in Management

The DuPree College of Management allows a specified number of electives taken in another school at Georgia Tech to be applied toward the requirements for the Master of Science in Management (MSM) degree. Persons interested in graduate degrees in management and in mechanical engineering should consult with advisors in the College of Management as well as the Woodruff School, because admissions requirements for both programs must be met.

Multidisciplinary Programs

Mechanical engineering students may plan electives that satisfy simultaneously the requirements of the degree program and a designated multidisciplinary field within the College of Engineering, thus earning both a graduate degree and a certificate indicating expertise in a related specialty. For a complete description of these and other multidisciplinary programs, see page 122.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

MECHANICAL ENGINEERING

ME 1750. Introduction to Bioengineering
3-0-3.
An introduction to the field of bioengineering, including the application of engineering principles and methods to problems in biology and medicine, the integration of engineering with biology, and the emerging industrial opportunities. Crosslisted with AE, CHE, ECE, and MSE 1750.

ME 1770. Introduction to Engineering Graphics and Visualization
2-3-3. Co-requisite: MATH 1501.
Introduction to engineering graphics and visualization including sketching, line drawing, simple wire-frame and solid modeling. Development and interpretation of drawings and specifications for product realization. Crosslisted with AE and CEE 1770.

ME 2016. Computing Techniques
3-0-3. Prerequisites: CS 1301 and MATH 1502; Co-requisite: MATH 2403.
An introduction to the use of computers and MATLAB programming for the solution of mechanical engineering problems. Topics include sources of error in computing, the use of modular software design, basic numerical methods, and signal processing.

ME 2110. Creative Decisions and Design
2-3-3. Prerequisites: AE 1770 or CEE 1770 or ME 1770; Co-requisites: ME 2016 and ME 2751.
To learn fundamental techniques for creating, analyzing, synthesizing, and implementing design solutions to open-ended problems with flexibility, adaptability, and creativity through team and individual efforts.

ME 2202. Dynamics of Rigid Bodies
3-0-3. Prerequisites: ME 2016 and ME 2201.
Kinematics and dynamics of particles and rigid bodies in one, two, and three dimensions. Work-energy and impulse-momentum concepts.

ME 2751. Introduction to Mechanics
3-0-3. Prerequisite: PHYS 2211; Co-requisite: MATH 2401.
Forces and moments; equilibrium in two and three dimensions; multiforce members; friction; stress and strain; axially loaded members, torsion, and bending of beams. Crosslisted with AE 2751.

ME 3015. System Dynamics and Control
4-0-4. Prerequisites: MATH 2403 and ME 2016 and ME 2022 and ECE 3710; Co-requisite: ECE 3741.
Dynamic modeling and response of systems with mechanical, hydraulic, thermal, and/or electrical elements. Linear feedback control systems design and analysis in time and frequency domains.

ME 3056. Experimental Methodology Laboratory
1-3-2. Prerequisites: ME 2016 and ME 3115 and ME 3201 and ME 3322 and ME 3340 and MATH 2403; Co-requisites: MATH 3770 and ME 3345.
Introduction to basic instrumentation used in mechanical engineering, including calibration, use, precision, and accuracy. Consideration of error, precision, and accuracy in experimental measurements.

ME 3180. Machine Design
3-0-3. Prerequisites: (AE 1770 or ME 1770 or CEE 1770) and ME 2016 and ME 3201.
The selection, analysis, and synthesis of springs, joining and fastening methods, bearings, shafts, gears, and other elements. Design of assemblies. Computer-based methods.

ME 3201. Mechanics of Materials
3-0-3. Prerequisites: ME 2016 and ME 2201; Co-requisites: MATH 2403 and MSE 2001.
Analysis of stress and strain applied to beams, pressure vessels, and combined loading; problems involving resistance of materials to plastic deformation, fracture, fatigue, and creep.

ME 3322. Thermodynamics
3-0-3. Prerequisites: PHYS 2212 and MATH 2403 and ME 2016.
Introduction to thermodynamics. Thermodynamic properties, energy and mass conservation, entropy and the second law. Second-law analysis of thermodynamic systems, gas cycles, and vapor cycles.

ME 3340. Fluid Mechanics
3-0-3. Prerequisites. MATH 2403 and ME 2202; Co-requisite: ME 3322.
The fundamentals of fluid mechanics. Topics include fluid statics, control-volume analysis, the Navier-Stokes equations, similitude, viscous, inviscid and turbulent flows, boundary layers.

ME 3345. Heat Transfer
3-0-3. Prerequisites: MATH 2403 and ME 3322.
Introduction to the study of heat transfer, transport coefficients, steady-state conduction, transient conduction, radiative heat transfer, and forced and natural convection.

ME 3720. Introduction to Fluid and Thermal Engineering
3-0-3. Prerequisites: CHEM 1211 and MATH 2403 and PHYS 2211.
Theory and application, but no exhaustive treatment, of fluid mechanics, thermodynamics, and heat transfer in analysis and design of fluid and thermal energy systems. (No credit for ME and NRE majors.)

ME 4041. Interactive Computer Graphics and Computer-Aided Design
3-0-3. Prerequisites: ME 2016 and ME 3180 and ME 4315.
Principles of geometric modeling, finite-element method, and interactive computer graphics hardware and software. CAD and CAE applications in thermal and mechanical design problems. Design projects.

ME 4053. Mechanical Engineering Systems Laboratory
1-3-2. Prerequisites: ME 3056 and ME 3345 and (MATH 3770 or ISYE 3770).
Measurement and analysis of mechanical, acoustic, manufacturing, thermodynamic, fluid, and heat transfer phenomena. Emphasis on data acquisition, reduction, and analysis and report preparation.

ME 4055. Experimental Engineering
0-3-1. Prerequisite: ME 4053.
Application of experimental techniques to engineering problems involving various mechanical engineering processes and systems. Open-ended investigations are accomplished by teams.

ME 4113. Kinematics and Dynamics of Linkages
3-0-3. Prerequisite: ME 2202.
Analysis and synthesis of n-bar, cam-follower, and gear-train systems. Balancing of rotating and reciprocating systems.

ME 4171. Environmentally Conscious Design and Manufacturing
3-0-3.
Including environmental considerations in engineering design; reducing environmental impact by design; recycling; material selection; de- and remanufacturing; life-cycle considerations, analyses, trade-offs; ISO 14000.

ME 4172. Designing Sustainable Engineering Systems
3-0-3.
Understanding sustainability in the context of market forces, availability of resources, technology, and society. Methods for identifying, modeling, and selecting sustainable designs.

ME 4182. Capstone Design
1-6-3. Prerequisites: ME 3180 and ME 4110 and ME 4210 and ME 4316.
Teams apply a systematic design process to real multidisciplinary problems. Problems selected from a broad spectrum of interest areas, including biomedical, ecological, environmental, mechanical, and thermal.

ME 4189. Structural Vibrations
3-0-3. Prerequisite: ME 3015.
Single and multi-degree-of-freedom systems as well as continuous systems are analyzed for their vibrational response characteristics using both exact and approximate methods.

ME 4193. Tribological Design
3-0-3. Prerequisites: ME 3201 and ME 3340.
Analysis of tribological aspects of machine components, including friction, lubrication, and wear. Group design project to optimize system tribological performance.

ME 4210. Manufacturing Processes and Engineering
3-0-3. Prerequisites: (MATH 3770 or ISYE 3770) and ME 3340 and ME 3345.
Major manufacturing processes, their capabilities, analysis and economics. Manufacturing process selection.

ME 4211. Manufacturing Engineering and Process Applications
3-3-4. Prerequisites: (MATH 3770 or ISYE 3770) and ME 3201.
Advanced treatment of manufacturing processes. Machining, casting, metal forming, polymer processing, manufacturing systems, and process planning are major topics. Laboratory practice supplements classroom.

ME 4213. Materials Selection and Failure Analysis
3-0-3. Prerequisite: ME 3201.
Principles of selecting both materials and processes required for mechanical design as well as failure analysis. Mechanics and materials knowledge used in solving practical problems.

ME 4315. Energy Systems Analysis and Design
3-0-3. Prerequisites: (AE 1770 or CEE 1770 or ME 1770) and ISYE 3025 and ME 3340 and ME 3345.
Integrated concepts, laws, and methodologies from thermal sciences are used to analyze, model, and design energy systems and to predict system performance for fixed designs.

ME 4321. Refrigeration and Air Conditioning
3-0-3. Prerequisites: ME 3322 and ME 3340 and ME 3345.
Application of thermodynamics principles to analysis and design of refrigeration and air-conditioning systems, absorption and heat-driven systems, gas-vapor mixture phychrometrics, load estimates, delivery, and control.

ME 4324. Power Generation Technology
3-0-3. Prerequisites: ISYE 3025 and ME 3340 and ME 3345.
Technology review and application of engineering sciences and economics to the analysis and design of power generation systems. Fossil, nuclear, and renewable energy systems are considered.

ME 4330. Heat and Mass Exchangers
3-0-3. Prerequisites: ME 3340 and ME 3345.
Heat transfer, fluid flow, and thermodynamics principles applied to the analysis and design of heat and mass exchangers, periodic regenerators, and cooling towers.

ME 4340. Applied Fluid Mechanics
3-0-3. Prerequisites: ME 3340 and ME 3345.
Advanced study in three areas of fluid mechanics. Topics may be chosen from turbomachinery, flow measurement, compressible flow, applied aerodynamics, and others.

ME 4342. Computational Fluid Dynamics
2-3-3. Prerequisites: ME 3340 and ME 3345.
An introduction to computational fluid dynamics (CFD) in mechanical engineering. The theory and numerical techniques of CFD. Modern CFD software including grid generation and flow visualization tools will be used. Projects with complex fluid-flow systems.

ME 4447. Microprocessor Control of Manufacturing Systems
2-3-3. Prerequisites: ME 3015 and ME 4210.
Lectures address the fundamental aspects of manufacturing elements and microprocessors and their applications. Hands-on application of machine and machine tool control will be stressed.

ME 4450. Robotics
3-0-3. Prerequisite: ME 3015.
Mathematical modeling, simulation, and control of robotic systems with mechanical and sensory elements.

ME 4757. Biofluid Mechanics
3-0-3. Prerequisites: AE 2020 or ME 3340.
Introduction to the study of blood flow in the cardiovascular system. Emphasis on modeling and the potential of flow studies for clinical research application. Crosslisted with AE and CHE 4757.

ME 4758. Biosolid Mechanics
3-0-3. Prerequisites: MATH 2403 and ME 3201.
The mechanics of living tissue, e.g., arteries, skin, heart muscle, ligament, tendon, cartilage, and bone. Constitutive equations and some simple mechanical models. Mechanics of cells. Applications. Crosslisted with AE and CHE 4758.

ME 4760. Engineering Acoustics and Noise Control
3-0-3.
Study of acoustics related to noise and its control; acoustic terminology, wave propagation, wave equation solutions, instrumentation, data processing, room acoustics, noise control, hearing, noise legislation. Crosslisted with AE 4760.

ME 4775. Polymer Science and Engineering I: Formation and Properties
3-0-3. Prerequisites: CHEM 2312 and CHEM 3411.
An introduction to the chemistry, structure, and formation of polymers, physical states and transitions, physical and mechanical properties of polymer fluids and solids. Crosslisted with CHEM, CHE, MSE, and TFE 4775.

ME 4776. Polymer Science and Engineering II: Analysis, Processing, and Laboratory
1-6-3. Prerequisites: CHE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or TFE 4775.
Polymer faabrication processes and methods of characterization and identification of polymers are presented. Experiments in polymerization, processing, and property evaluation of polymers. Crosslisted with CHE, CHEM, MSE, and TFE 4776.

ME 4777. Introduction to Polymer Science and Engineering
3-0-3. Prerequisite: MATH 2403.
An introduction to the structure and formation of polymers, physical states and transitions, physical and mechanical properties of polymer fluids and solids, and processing of polymers. Crosslisted with CHE, MSE, and TFE 4777.

ME 4781. Biomedical Instrumentation
3-0-3. Prerequisite: ECE 3050.
A study of medical instrumentation from a systems viewpoint. Pertinent physiological and electro-physiological concepts will be covered. Crosslisted with CHE and ECE 4781.

ME 4782. Biosystems Analysis
3-0-3. Prerequisite: MATH 1502.
Analytical methods for modeling biological systems, including white-noise protocols for characterizing nonlinear systems. Crosslisted with CHE and ECE 4782.

ME 4791. Mechanical Behavior of Composites
3-0-3. Prerequisite: ME 3201.
Stress-strain behavior of composites, properties of matrix and reinforcing materials, mechanics of fiber-reinforced composites, lamina and laminate analysis, and mechanical performance. Crosslisted with AE, CEE, CHE, MSE, and TFE 4791.

ME 4793. Composite Materials and Processes
3-0-3. Prerequisites: PHYS 2212 and CHEM 1211.
Basic principles of selection and design of composite materials and their manufacturing and testing. Cost factors. (Laboratory exercises on manufacturing and tests.) Crosslisted with AE, CEE, MSE, and CHE 4793.

ME 4794. Composite Materials and Manufacturing
2-3-3. Prerequisites: CHEM 1211 and PHYS 2212.
Basic principles of selection and design of composite materials and their manufacturing and testing. Cost factors. (Laboratory exercises on manufacturing and tests.) Crosslisted with AE, CEE, CHE, MSE, and TFE 4794.

ME 4801. Special Topics, Mechanical Engineering
1-0-1.
Special topic offerings of current interest not included in regular courses.

ME 4802. Special Topics, Mechanical Engineering
2-0-2.
Special topic offerings of current interest not included in regular courses.

ME 4803. Special Topics, Mechanical Engineering
3-0-3.
Special topic offerings of current interest not included in regular courses.

ME 4804. Special Topics, Mechanical Engineering
4-0-4.
Special topic offerings of current interest not included in regular courses.

ME 4805. Special Topics, Mechanical Engineering
5-0-5.
Special topic offerings of current interest not included in regular courses.

ME 4811. Special Topics
1-0-1.

ME 4812. Special Topics
2-0-2.

ME 4813. Special Topics
3-0-3.

ME 4814. Special Topics
4-0-4.

ME 4815. Special Topics
5-0-5.

ME 4821. Special Topics
1-0-1.

ME 4822. Special Topics
2-0-2.

ME 4823. Special Topics
3-0-3.

ME 4824. Special Topics
4-0-4.

ME 4825. Special Topics
5-0-5.

ME 4831. Special Topics
1-0-1.

ME 4832. Special Topics
2-0-2.

ME 4833. Special Topics
3-0-3.

ME 4834. Special Topics
4-0-4.

ME 4835. Special Topics
5-0-5.

ME 4901,-2,-3. Special Problems, Mechanical Engineering
Credit hours to be arranged.
Individual studies in certain specialized areas, and mathematical analyses and/or experimental investigations of problems of current interest in mechanical engineering.

ME 6101. Engineering Design
3-0-3.
Design concepts, processes, and methodologies, including quality and robustness. Group project.

ME 6102. Designing Open Engineering Systems
3-0-3.
Decision-based integrated product and process development, meta-design, and decision support problems; mathematical modeling of decisions involving ambiguity and uncertainty; critical thinking and analysis.

ME 6103. Optimization in Engineering Design
3-0-3.
Use of single and multi-objective optimization in modeling and solving mechanical engineering design problems. Formulations, solution algorithms, validation and verification, computer implementation. Project.

ME 6104. Computer-Aided Design
3-0-3.
Fundamentals of CAD, including geometric and solid modeling, parametric representations, features, and human-machine interactions. Applications to design, analysis, and manufacturing.

ME 6124. Finite-Element Method: Theory and Practice
3-0-3.
Line, plane, solid, plate, and shell elements theory; practical aspects of modeling; applications in Mechanical Engineering; final project.

ME 6201. Principles of Continuum Mechanics
3-0-3. Prerequisite: MATH 4581.
Introductory treatment of the fundamental, unifying concepts of the mechanics of continua.

ME 6202. Energy and Variational Methods in Elasticity and Plasticity
3-0-3. Prerequisites: MATH 2403 and ME 3201.
Applications of energy and variational methods in engineering mechanics to elastic, plastic, and dynamical behavior of deformable media.

ME 6203. Inelastic Deformation of Solids
3-0-3. Prerequisite: ME 6201.
Phenomenological aspects of nonlinear material behavior and deformation with emphasis on model development.

ME 6204. Micromechanics of Materials
3-0-3. Prerequisite: ME 6201.
Fundamental concepts of micromechanics of solids with emphasis on application to composite materials.

ME 6222. Manufacturing Processes and Systems
3-0-3. Prerequisite: ME 4210.
Materials processing analysis and selection. Manufacturing systems design. Economic analysis.

ME 6223. Automated Manufacturing Process Planning
3-0-3. Prerequisite: ME 6222.
Fundamentals of process planning. Automated process planning approaches and algorithms. Geometric modeling for process planning. Modeling and analysis of flexible fixturing systems. Mechanical assembly planning.

ME 6224. Machine Tool Analysis and Control
3-0-3. Prerequisite: ME 6222.
Mechanics and dynamics of machining, machine tool components and structures, sensors and control of machine tools, machine process planning and optimization.

ME 6225. Metrology and Measurement Systems
3-0-3. Prerequisites: ME 3015 and ME 6222.
Metrology techniques and procedures. Precision manufacturing system design and analysis.

ME 6226. Fundamentals of Semiconductor Manufacture and Assembly
3-0-3. Prerequisite: ME 6222.
Basic mechanical and materials processes in production including silicon boule growth, plastic encapsulation, interconnect metal migration, solder joining, printing, manufacturing process cost analysis.

ME 6241. Tribological Design
3-0-3. Prerequisites: ME 3201 and ME 3340.
Introduction to the study of friction, lubrication, and wear. Design of tribological components such as journal bearings, slider bearings, rolling element bearings, and brake systems.

ME 6242. Mechanics of Contact
3-0-3. Prerequisite: ME 6201.
Mechanics of surface contact, with emphasis on tribological interactions as in rolling element bearings, slider bearings, mechanical seals, and materials processing.

ME 6243. Fluid Film Lubrication
3-0-3.
Analytical and numerical investigation of full film compressible and incompressible hydrodynamic lubrication problems for steady and unsteady conditions.

ME 6244. Rotordynamics
3-0-3.
Analysis and design of shafts for rotating machinery. Torsional vibration, synchronous and nonsynchronous whirl, stability, gyroscopic effects, hydrodynamic bearings, hysteresis, squeeze film dampers, and balancing.

ME 6301. Conduction Heat Transfer
3-0-3. Prerequisite: ME 3345.
Steady and transient one- and multidimensional conduction. Emphasis on analytical methods, numerical techniques, and approximate solutions.

ME 6302. Convection Heat Transfer
3-0-3. Prerequisite: ME 3345.
Convection (forced and free) in laminar and turbulent, internal and external flows. Analogy between momentum and heat transfer. Scaling laws and modeling.

ME 6303. Thermal Radiation Heat Transfer
3-0-3. Prerequisite: ME 3345.
Fundamentals of thermal radiation, blackbody radiation, surface characteristics, exchange in enclosures, radiation through continua, and combined mode heat transfer.

ME 6304. Principles of Thermodynamics
3-0-3. Prerequisite: ME 3322.
Fundamentals of thermodynamics including energy, entropy, and energy analysis; property relations, equilibrium conditions, and evaluation of properties.

ME 6305. Applications of Thermodynamics
3-0-3. Prerequisite: ME 6304.
Applications of the first and second laws of thermodynamics to analysis and design optimization of power and refrigeration systems incorporating heat exchangers and combustion processes.

ME 6306. Advanced HVAC and Refrigeration
3-0-3. Prerequisite: ME 3322.
Scientific principles associated with environmental systems and supporting analyses leading to the design of heating, ventilating, air conditioning, and refrigeration systems.

ME 6401. Linear Control Systems
3-0-3. Prerequisite: ME 3015.
Theory and applications of linear systems, state space, stability, feedback controls, observers, LQR, LQG, Kalman filters.

ME 6402. Nonlinear Control Systems
3-0-3. Prerequisite: ME 6401.
Analysis of nonlinear systems, geometric control, variable structure control, adaptive control, optimal control, applications.

ME 6403. Digital Control Systems
3-0-3. Prerequisite: ME 3015.
Comprehensive treatment of the representation, analysis, and design of discrete-time systems. Techniques include z- and w-transforms, direct method, control design, and digital tracking.

ME 6404. Advanced Control System Design and Implementation
2-3-3. Prerequisite: ME 6403.
Analysis, synthesis, and implementation techniques of continuous-time and real-time control systems using classical and state-space methods.

ME 6405. Introduction to Mechatronics
2-3-3. Prerequisite: ME 3015.
Modeling and control of actuators and electro-mechanical systems. Performance and application of microprocessors and analog electronics to modern mechatronic systems.

ME 6406. Machine Vision
3-0-3.
Design of algorithms for vision systems for manufacturing, farming, construction, and the service industries. Image processing, optics, illumination, feature representation.

ME 6407. Robotics
3-0-3. Prerequisites: ME 3015 and EE 3085.
Analysis and design of robotic systems including arms and vehicles. Kinematics and dynamics. Algorithms for describing planning, commanding, and controlling motion force.

ME 6441. Dynamics of Mechanical Systems
3-0-3. Prerequisite: ME 3015.
Motion analysis and dynamics modeling of systems of particles and rigid bodies in three-dimensional motion.

ME 6442. Vibration of Mechanical Systems
3-0-3. Prerequisites: ME 3015 and ME 3201.
Introduction to modeling and oscillatory response analysis for discrete continuous mechanical and structural systems.

ME 6443. Variational Methods in Engineering
3-0-3.
Calculus of variations, Hamilton's principle and Lagrange's equations, Sturm-Liouville problems, approximation techniques.

ME 6444. Nonlinear Systems
3-0-3.
Investigation of nonlinear systems using analytical and numerical techniques.

ME 6449. Acoustic Transducers and Signal Analysis
2-3-3. Prerequisites: AE 6760 or ME 6760.
Acoustic instrumentation and methods of signal analysis.

ME 6452. Wave Propagation in Solids
3-0-3. Prerequisites: ME 6202 or (AE 6760 or ME 6760).
Wave motion in solids, wave equations, analytical and numerical solutions, ultrasonic NDE.

ME 6554. Engineering Database Management Systems
3-0-3.
Modeling and managing engineering information systems, integration of design and manufacturing functions in engineering product development, logical models of engineering product and processes.

ME 6601. Introduction to Fluid Mechanics
3-0-3.
The fundamentals of fluid mechanics. Derivation of the governing equations of motion. An introduction to viscous, inviscid, turbulent, and boundary-layer flows.

ME 6602. Viscous Flow
3-0-3. Prerequisite: ME 6601.
The mechanics of Newtonian viscous fluids. The use of modern analytical techniques to obtain solutions for flows with small and large Reynolds numbers.

ME 6603. Inviscid Flow
3-0-3. Prerequisites: MATH 4320 and ME 6601.
The mechanics of inviscid fluid flow. Two- and three-dimensional potential flow, superposition, conformal transformations, Schwartz-Christoffal transformations, ideal-flow aerodynamics, and free-surface waves.

ME 6604. Turbulence
3-0-3. Prerequisite: ME 6601.
The mechanics of turbulent flows. Governing equations, correlation tensors, spectra, isotropic turbulence, boundary-free shear flows, wall-bound shear flows, and measurement techniques.

ME 6621. Perturbation Methods in Mechanics
3-0-3. Prerequisite: MATH 4581.
Asymptotic techniques for the solution of regular and singular problems in mechanics.

ME 6622. Experimental Methods
3-0-3.
Experimental methods in mechanics. Includes measurement techniques, instrumentation, data acquistion, signal processing, and linear and digital electronics.

ME 6758. Numerical Methods in Mechanical Engineering
3-0-3.
Numerical methods for solution of engineering problems; initial, eigenvalue, and boundary value problems; computational stability for ordinary and linear partial differential equations. Crosslisted with NRE and HP 6758.

ME 6759. Materials in Environmentally Conscious Design and Manufacturing
3-0-3.
Covers the environmental impact of materials choices and quantitative measure of life-cycle assessment and environmental burden. The Natural Step philosophy will be used as a model for the overall approach. Crosslisted with MSE and TFE 6759.

ME 6760. Acoustics I
3-0-3. Prerequisite: MATH 2403.
Fundamental principles governing the generation, propagation, reflection, and transmission of sound waves in fluids. Crosslisted with AE 6760.

ME 6761. Acoustics II
3-0-3. Prerequisites: ME 6760 or AE 6760 or ESM 6760.
Radiation and scattering of sound waves in fluids, duct acoustics, dissipation phenomena. Crosslisted with AE 6761.

ME 6762. Applied Acoustics
3-0-3. Prerequisites: ME 6760 or AE 6760 or ESM 6760.
Mufflers, resonators, acoustic materials, barriers, industrial noise, room acoustics, active noise control. Crosslisted with AE 6762.

ME 6765. Kinetics and Thermodynamics of Gases
4-0-4.
Thermodynamics of nonreacting and reacting gas mixtures. Introductory quantum theory, statistical thermodynamics, and gas kinetic theory. Crosslisted with AE 6765.

ME 6766. Combustion
3-0-3. Prerequisites: ME 6304 or ME 6765 or AE 6765.
Introductory chemical kinetics, deformations and deflagrations, laminar flame propagation in premixed gases, ignition and quenching, laminar diffusion flames and droplet burning, turbulent reacting flows. Crosslisted with AE 6766.

ME 6767. Advanced Topics in Combustion
3-0-3. Prerequisites: ME 6766 or AE 6766.
Turbulent combustion, combustion instability and control, solid propellents and explosives, chemical kinetics, pollutant formation and destruction, computational methods for reacting flow. Crosslisted with AE 6767.

ME 6768. Polymer Structure, Physical Properties, and Characterization
3-0-3. Prerequisites: CHE 4776 or CHEM 4776 or ME 4776 or MSE 4776 or TFE 4776.
Formulations and analysis of molecular and phenomenological models of elastic and viscoelastic behavior, development and description of structure, and fundamental aspects of structure-property relations. Crosslisted with CHE, MSE, and TFE 6768.

ME 6778. Introduction to Biomaterials
3-0-3.
Introduction to a variety of biomaterials and their biomedical applications. Crosslisted with CHE, BMED, and TFE 6778.

ME 6782. Cellular Engineering
3-0-3.
Engineering analysis of cellular systems. Crosslisted with BMED and CHE 6782.

ME 6783. Orthopaedic and Injury Biomechanics
3-0-3.
Structure-function relationships in a variety of tissues, with an emphasis on orthopaedic and neural systems through an understanding of mechanical adaptational, and failure properties. Crosslisted with BMED 6783.

ME 6784. Cardiovascular Biomechanics
3-0-3. Prerequisites: ME 2201 and ME 3340.
Mechanical analysis of the cardiovascular system emphasizing the normal and pathologic function in relation to the clinical cardiovascular medicine. Crosslisted with BMED and CHE 6784.

ME 6788. Legal Issues in Biomedical Engineering
3-0-3.
Study and analysis of U.S. government laws applicable to the development and clinical use of biomedical engineering technology. Crosslisted with BMED, CHE, ECE, and MGT 6788.

ME 6789. Technology Transfer in Biomedical Engineering
3-0-3.
Team discussion and case studies of issues in biomedical engineering technology transfer including licensing, financial capital, safety and efficacy studies, clinical trials, and strategic planning. Crosslisted with BMED, ECE, CHE, and MGT 6789.

ME 6793. Systems Pathophysiology
3-0-3.
Overview of human pathophysiology from a quantitative perspective. Emphasis on systems of interest to bioengineering faculty. Introduction to quantitative models for biological systems. Crosslisted with BMED, CHE and ECE 6793.

ME 6794. Tissue Engineering
3-0-3.
Biological, engineering, and medical issues in developing tissue engineered constructs. Emphasis in the integration of these disciplines at a basic molecular and cell biology level. Crosslisted with BMED and CHE 6794.

ME 6795. Mathematical, Statistical, and Computational Techniques in Materials Science
3-0-3.
Emphasizes the fundamental physical, analytical, and mathematical techniques commonly encountered in materials engineering including stress and strain, crystallographic and orientation transformations, X-ray, TEM, and solid-state concepts. Crosslisted with MSE and TFE 6795.

ME 6796. Structure-Property Relationships in Materials
3-0-3.
Introduction to the multiscale structure effects on material properties. For MSE students this course will prepare students for future in-depth courses. For non-MSE students, the course will provide a background in materials and may serve as part of the program of study for a minor in materials. Crosslisted with MSE and TFE 6796.

ME 6797. Thermodynamics and Kinetics of Microstructural Evolution
3-0-3.
The reduction of chemical free energy, strain energy, and interfacial energy controls the kinetics of diffusional transformations. These factors are explored from the point of view of processing and stability of the microstructure during service. Crosslisted with MSE and TFE 6797

ME 7000. Master's Thesis
Credit hours to be arranged

ME 7101. Seminar in Engineering Design
3-0-3. Prerequisite: ME 6101.
Reading from the literature, presentations, and discussions on current theories and methods in engineering design.

ME 7201. Computational Mechanics of Materials
2-3-3. Prerequisite: ME 6201; Co-requisite: ME 6122.
Computational treatments of material and geometric nonlinearity, with emphasis on rate-dependent elastoplasticity and fracture.

ME 7203. Advanced Constitutive Relations for Solids
3-0-3. Prerequisite: ME 6201.
Advanced treatment of constitutive laws for nonlinear behavior of solids. Coupled thermomechanical laws and underlying physical and thermodynamical bases. Behavior of media with underlying substructure.

ME 7204. Advanced Topics in Micromechanics
3-0-3. Prerequisite: ME 6201
Advanced topics in micromechanics of materials, with emphasis on fracture and damage of materials with random microstructures.

ME 7226. Interface and Surface Properties
3-0-3. Prerequisites: PHYS 4222 and ME 6242.
Physical phenomena associated with surfaces and interfaces. Gas-solid, liquid-solid, and solid-solid interactions associated with physics, chemistry, and engineering.

ME 7227. Rapid Prototyping in Engineering
3-0-3. Prerequisites: ME 6104 and ME 6222.
Rapid prototyping technologies in engineering design. Physical principles, materials, materials processing. Laboratory demonstrations and project.

ME 7228. Thermo-Mechanical Reliability in Electronic Packaging
3-0-3. Prerequisites: ME 6122 and ME 6222.
Modeling and validation of thermomechanical behavior of printed wiring board and PWB assembly; micro-electronic packaging, packaging materials, manufacturing process modeling, reliability, failure modes.

ME 7301. Transport Phenomena in Multiphase Flow
3-0-3. Prerequisites: ME 6301 and ME 6302 and ME 6602.
Gas-liquid, two-phase flow patterns, basic and empirical models; conservation equations and closure relations; pool and convective boiling; aerosol transport; condensation.

ME 7302. Advanced Topics in Heat Transfer
3-0-3. Prerequisites: ME 6301 and ME 6302 and ME 6303 and ME 6602.
Latest advances in heat transfer; microscale convection; boiling and two-phase flow; liquid-metal-heat transfer; thermal management of micro-electronics; high-temperature fuel cells.

ME 7442. Vibration of Continuous Systems
3-0-3. Prerequisite: ME 6442.
Equations of motion and oscillatory response of dynamic systems modeled as continuous media.

ME 7601. Computational Fluid Mechanics
3-0-3. Prerequisite: ME 6601.
Numerical techniques for the solution of fluid flows. Includes finite difference, finite-element, finite volume, spectral, and boundary-element methods.

ME 7602. Hydrodynamic Stability
3-0-3. Prerequisite: ME 6601.
Hydrodynamic stability of fluid flows using linear, energy, and nonlinear stability theories. Taylor-Couette, buoyancy driven, surface-tension driven, shear, and thin-film flows.

ME 7753. Fundamentals of Fracture Mechanics
3-0-3. Prerequisites: ESM 3311, MATE 3463, and ESM 6321 or ESM 6341 or consent of the instructor.
Advanced study of failure of structural materials under load, mechanics of fracture, and microscopic and macroscopic aspects of the fracture of engineering materials. Also taught as MSE 7753.

ME 7754. Advanced Fracture Mechanics
3-0-3. Prerequisites: ME 7753, ESM 6621 or ESM 6341, and consent of the instructor
Nonlinear fracture mechanics including fracture under elastic-plastic conditions, concepts of time-dependent fracture mechanics, advanced test methods, J-integral theory, creep crack growth, fatigue crack growth under gross plasticity. Also taught as MSE 7754.

ME 7757. Teaching Practicum
1-6-3.
Supervised teaching for doctoral students. Teaching techniques, course and curriculum design, student evaluation methods and criteria. Students may, in some instances, prepare and present lectures. Crosslisted with NRE and HP 7757.

ME 7764. Acoustic Propagation
3-0-3. Prerequisites: AE 6760 or ME 6760.
Propagation of sound in inhomogeneous fluids; ray acoustics, ocean and atmospheric acoustics, nonlinear acoustics. Crosslisted with AE 7764.

ME 7771. Mechanics of Polymer Solids and Fluids
3-0-3.
Continuum mechanics of solids and fluids; mechanics of deformation of anisotropic polymers; yield, breaking, and fatigue; non-Newtonian viscous and viscoelastic behavior of polymer fluids. Crosslisted with CHE, MSE, and TFE 7771.

ME 7772. Fundamentals of Fracture Mechanics
3-0-3. Prerequisites: ME 3201 or MSE 3005.
Advanced study of failure of structural materials under load, mechanics of fracture, and microscopic and macroscopic aspects of the fracture of engineering materials. Crosslisted with AE, CEE, CHE, and MSE 7772.

ME 7773. Advanced Fracture Mechanics
3-0-3.
Nonlinear fracture mechanics including elastic-plastic and time-dependent fracture, advanced test methods, J-integral theory, and extensions. Crosslisted with AE, CEE, CHE, and MSE 7773.

ME 7774. Fatigue of Materials and Structures
3-0-3. Prerequisites: AE 7772 or CEE 7772 or CHE 7772 or ME 7772 or MSE 7772.
Mechanical and microstructural aspects of nucleation and growth of cracks under cyclic loading conditions, notch effects, cumulative damage, multiaxial loading, and fatigue crack propagation. Crosslisted with AE, CEE, CHE, and MSE 7774.

ME 7775. Topics in Fracture and Fatigue of Metallic and Composite Structures
3-0-3. Prerequisites: AE 2751 or ME 2751.
Brittle and ductile failure criteria. Failure prediction in composite structures. Free-edge and internal delamination. Anisotropic cracks. Fatigue behavior of composites and comparison with metal fatigue. Crosslisted with AE, CHE, and MSE 7775.

ME 7791. Damage, Failure, and Durability of Composite Materials
3-0-3. Prerequisites: AE 4791 or CHE 4791 or CEE 4791 or ME 4791 or MSE 4791.
Analysis and failure of fiber-reinforced composite material systems. Mechanisms of toughening, multiple cracking mechanisms. Failure in woven fabric, braided, and special geometry composites. Crosslisted with AE, CHE, CEE, MSE, and TFE 7791.

ME 7792. Advanced Mechanics of Composites
3-0-3. Prerequisites: AE 4791 or CEE 4791 or CHE 4791 or ME 4791 or MSE 4791 or TFE 4791.
Anisotropic elasticity, hygrothermal behavior, stress analysis of laminated composties including 3D effects, stress concentrations, free-edge effects, thick laminates, adhesive and mechanical connections, fracture of composites. Crosslisted with AE, CHE, CEE, MSE, and TFE 7792.

ME 7793. Manufacturing of Composites
3-0-3. Prerequisite: AE 4793 or AE 4794 or CEE 4793 or CEE 4794 or CHE 4793 or CHE 4794 or ME 4793 or ME 4794.
Major manufacturing techniques of metal-ceramic and polymer-matrix composites. Modeling of processes with emphasis on fundamental mechanisms and effects. Crosslisted with AE, CEE, CHE, MSE, and TFE 7793.

ME 8010,-1,-2. Seminars in Mechanical Engineering
1-0-1, each.
Seminars involving current research projects presented by graduate students, faculty, and invited speakers.

ME 8801,-2,-3,-4,-5,-6. Special Topics in Manufacturing
1, 2, 3, 4, 5, 6 credit hours, respectively.
Special topic offerings of current interest in manufacturing not included in regular courses.

ME 8811,-2,-3,-4,-5,-6. Special Topics in Computer-Aided Engineering and Design
1, 2, 3, 4, 5, 6 credit hours, respectively.
Special topic offerings of current interest in computer-aided engineering not included in regular courses.

ME 8821,-2,-3,-4,-5,-6. Special Topics in Tribology
1, 2, 3, 4, 5, 6 credit hours, respectively.
Special topic offerings of current interest in tribology not included in regular courses.

ME 8831,-2,-3,-4,-5,-6. Special Topics in Thermal Sciences
1, 2, 3, 4, 5, 6 credit hours, respectively.
Special topic offerings of current interest in thermal sciences not included in regular courses.

ME 8841,-2,-3,-4,-5,-6. Special Topics in Automation and Mechatronics
1, 2, 3, 4, 5, 6 credit hours, respectively.
Special topic offerings of current interest in automation and mechatronics not included in regular courses.

ME 8851,-2,-3,-4,-5,-6. Special Topics in Acoustics and Dynamics
1, 2, 3, 4, 5, 6 credit hours, respectively.
Special topic offerings of current interest in acoustics and dynamics not included in regular courses.

ME 8861,-2,-3,-4,-5,-6. Special Topcis in Fluid Mechanics
1, 2, 3, 4, 5, 6 credit hours, respectively.
Special topic offerings of current interest in fluid mechanics not included in regular courses.

ME 8871,-2,-3,-4,-5,-6. Special Topics in Bioengineering
1, 2, 3, 4, 5, 6 credit hours, respectively.
Special topic offerings of current interest in bioengineering not included in regular courses.

ME 8881,-2,-3,-4,-5,-6. Special Topics in Mechanics of Materials
1, 2, 3, 4, 5, 6 credit hours, respectively.
Special topic offerings of current interest in mechanics of materials not included in regular courses.

ME 8901,-2,-3,-4,-5,-6. Special Problems in Manufacturing
Credit hours to be arranged.
Individual studies and/or experimental investigation of problems of current interest in manufacturing.

ME 8911,-2,-3,-4,-5,-6. Special Problems in Computer-Aided Engineering and Design
Credit hours to be arranged.
Individual studies and/or experimental investigation of problems of current interest in computer-aided engineering and design.

ME 8921,-2,-3,-4,-5,-6. Special Problems in Tribology
Credit hours to be arranged.
Individual studies and/or experimental investigations of problems of current interest in tribology.

ME 8931,-2,-3,-4,-5,-6. Special Problems in Thermal Sciences
Credit hours to be arranged.
Individual studies and/or experimental investigations of problems of current interest in thermal sciences.

ME 8941,-2,-3,-4,-5,-6. Special Problems in Automation and Mechatronics
Credit hours to be arranged.
Individual studies and/or experimental investigations of problems of current interest in automation and mechatronics.

ME 8951,-2,-3,-4,-5,-6. Special Problems in Acoustics and Dynamics
Credit hours to be arranged.
Individual studies and/or experimental investigations of problems of current interest in acoustics and dynamics.

ME 8961,-2,-3,-4,-5,-6. Special Problems in Fluid Mechanics
Credit hours to be arranged.
Individual studies and/or experimental investigations of problems of current interest in fluid mechanics.

ME 8971,-2,-3,-4,-5,-6. Special Problems in Bioengineering
Credit hours to be arranged.
Individual studies and/or experimental investigations of problems of current interest in bioengineering.

ME 8981,-2,-3,-4,-5,-6. Special Problems in Mechanics of Materials
Credit hours to be arranged.
Individual studies and/or experimental investigations of problems of current interest in the mechanics of materials.

ME 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding graduate teaching assistantships.

ME 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding graduate research assistantships.

ME 9000. Doctoral Thesis
Credit hours to be arranged.

NUCLEAR AND RADIOLOGICAL ENGINEERING

NRE 2110. Introduction to Nuclear and Radiological Engineering
2-0-2.
Introduction to nuclear and radiological engineering; nuclear energy production and radiation technologies and their role of importance to society, their environmental impact.

NRE 3111. Nuclear Radiation Detection
1-3-2. Prerequisite: NRE 3301.
A laboratory introduction to the principles and characteristics of basic detectors for nuclear radiation and the electronic systems associated with them.

NRE 3301. Radiation Physics
3-0-3. Prerequisite: PHYS 2133.
Characteristics of atomic and nuclear radiations, transition probabilities, radioactivity, classical and quantum-mechanical derivations of cross sections, interactions of photon, neutron, and charged particles with matter.

NRE 3316. Radiation Protection Engineering
3-0-3. Prerequisites: MATH 2403 and NRE 3301.
Covers radiation dosimetry, biological effects of radiation, radiation-protection criteria and exposure limits, external radiation protection, internal radiation protection, and sources of human exposure.

NRE 4204. Nuclear Reactor Physics
4-0-4. Prerequisites: NRE 3301 and MATH 4581.
Covers physical principles of nuclear reactors. Topics include neutron diffusion theory, criticality and multigroup theory, slowing down theory, heterogeneity effects, and reactor kinetics.

NRE 4206. Radiation Physics Laboratory
1-3-2. Prerequisite: NRE 3111 and NRE 4204.
Measurements of reactor parameters such as approach to criticality, flux mapping, buckling, and diffusion length using subcritical assemblies. Neutron spectral measurements, shield transmission measurements, and other radiation field measurements.

NRE 4214. Reactor Engineering
3-0-3. Prerequisites: ME 3340 and ME 3345.
Nuclear heat generation; fuel elements' thermal analysis; single and two-phase flow and heat transfer in reactor systems; core thermal design, and treatment of uncertainties.

NRE 4232. Nuclear and Radiological Engineering Design
1-9-4. Prerequisite: NRE 4316.
Introduction to the methodologies of nuclear and radiological design. An open-ended design project that integrates all relevant engineering aspects is to be completed in this course.

NRE 4234. Nuclear Criticality Safety Engineering
2-3-3. Prerequisite: NRE 4204.
This course covers the theoretical concepts, the computational techniques, and the principal methods of criticality safety.

NRE 4266. Light Water Reactor Technology
3-0-3. Prerequisites: NRE 4204 and NRE 4214.
A systematic survey of the technology of both pressurized and boiling water reactors with emphasis on the nuclear stream supply system and its associated safety and control systems.

NRE 4316. Radiation Sources and Radioactive Materials Management
3-0-3. Prerequisites: NRE 3301; Co-requisite: NRE 4204.
Radiation sources; isotope production, depletion, and enrichment; nuclear reactor fuel cycle; nuclear and radioactive materials management; high-level radioactive waste.

NRE 4326. Methods for Radiation Applications
2-3-3. Prerequisite: NRE 4316.
Numerical and experimental methods for the application of radiation in industry and medicine.

NRE 4335. Radiation Imaging
3-0-3. Prerequisites: NRE 3111 and NRE 4204.
Introduction to camera and signal processing systems for medical and industrial imaging and dosimetry applications; associated instrumentation and film; and deconvolution/reconstruction algorithms.

NRE 4404. Radiological Assessment and Waste Management
3-0-3. Prerequisites: NRE 3316.
Mathematical models for movement in the environment. Scenario development for release, environmental transport, and exposure. Radioactive waste disposal facilities and waste disposal technology.

NRE 4430. Nuclear Regulatory Requirements
2-0-2. Prerequisite: NRE 3316.
This course introduces regulatory organizations and delineates their jurisdictions. It covers the fundamentals of regulations, the impacts on occupational workers, the public and the environment.

NRE 4610. Introduction to Plasma Physics and Fusion Engineering
3-0-3.
A first course in plasma physics and magnetic confinement fusion: basic plasma physics, magnetic confinement concepts, fusion engineering, and a review of the current status of fusion research.

NRE 4801,-2,-3,-4,-5. Special Topics
1, 2, 3, 4, 5 credit hours, respectively.
Special topic offerings of current interest not included in regular courses.

NRE 4901,-2,-3. Special Problems
Credit hours to be arranged.

NRE 6101. Transport Fundamentals
3-0-3.
Neutral and charged particle transport. Fluid mass, energy, and momentum transport. Models used in nuclear radiation transport; fluid hydrodynamics, radiative and plasma transport.

NRE 6102. Plasma Physics
3-0-3. Prerequisites: NRE 6101 and (NRE 6756 or HP 6756).
Physics of ionized plasmas. Magnetic confinement, kinetic and fluid theories, equilibrium, waves and stability, plasma-material interactions, atomic/molecular-plasma interactions, multispecies transport. Plasma processing applications.

NRE 6103. Computational Methods of Radiation Transport
3-0-3. Prerequisite: NRE 6101.
Deterministic and stochastic computational methods for solving transport equations of neutral particles.

NRE 6201. Reactor Physics
3-0-3. Prerequisite: NRE 6101.
Fundamentals of reactor physics for nuclear analysis of neutron chain reactors and for developing tools required for the design of those reactors.

NRE 6301. Reactor Engineering
3-0-3.
Two-phase flow, boiling heat transfer, fast reactor thermal-hydraulics, reactor thermal-hydraulics uncertainty analysis, loss-of-coolant-accidents. Reactor thermal-hydraulic accident analysis.

NRE 6401. Advanced Nuclear Engineering Design
1-6-3. Prerequisites: NRE 6102 and NRE 6201 and NRE 6301.
Synthesis of principles of nuclear engineering in the design of nuclear reactors and other facilities.

NRE 6434. Nuclear Criticality Safety Engineering
2-3-3. Prerequisite: NRE 4204.
Concepts, computational techniques, and the principal methods of criticality safety such as accident experience, standards, experiments, computer and hand calculations, limits, and regulations. Application to overall facility operation.

NRE 6501. Nuclear Fuel Cycle
3-0-3. Prerequisite: NRE 6201.
Fission fuel cycle, uranium mining and milling, enrichment. Fuel fabrication. In-core fuel management. Reprocessing and fuel-cycle economics. Spent-fuel waste management.

NRE 6755. Radiological Assessment and Waste Management
3-0-3. Prerequisite: HP 6401.
Critical analyses of sources and human exposures, mathematical models for movement through the biosphere, environmental transport, and exposure for nuclear facilities and waste disposal processing. Crosslisted with HP 6755.

NRE 6756. Radiation Physics
3-0-3.
Characteristics of atomic and nuclear radiation, transition probabilities, radioactivity and isotopes, cross sections, electromagnetic radiation, neutrons, and charged particle interaction with matter. Crosslisted with HP 6756.

NRE 6757. Radiation Detection
2-3-3. Prerequisites: NRE 6756 or HP 6756.
Introduction to the theory and application of radiation detectors, measurement methods, signal processing, and data analysis. Crosslisted with HP 6757.

NRE 6758. Numerical Methods in Mechanical Engineering
3-0-3.
Numerical methods for solution of engineering problems; initial, eigenvalue, and boundary value problems; computational stability for ordinary and linear partial differential equations. Crosslisted with ME and HP 6758.

NRE 7000. Master's Thesis
Credit hours to be arranged.

NRE 7103. Advanced Plasma Physics
3-0-3. Prerequisite: NRE 6102.
Classical and collective transport phenomena, plasma instabilities, plasma-materials interactions, and plasma edge physics. Emphasis on magnetic fusion, plasma processing, and other plasma applications research.

NRE 7203. Advanced Reactor Physics
3-0-3. Prerequisite: NRE 6102.
Advanced topics in reactor physics and transport theory.

NRE 7757. Teaching Practicum
1-6-3.
Supervised teaching for doctoral students. Teaching techniques, course and curriculum design student evaluation methods and criteria. Students may, in some instances, prepare and present lectures. Crosslisted with HP and ME 7757.

NRE 8011,-2. Seminars in Nuclear Engineering
1-0-1, each.
Seminars involving current research projects presented by graduate students, faculty, and invited speakers.

NRE 8801,-2,-3,-4,-5,-6. Special Topics in Nuclear Engineering
1, 2, 3, 4, 5, 6 credit hours, respectively.
Special topic offerings of current interest in nuclear engineering not included in regular courses.

NRE 8901,-2,-3,-4,-5,-6. Special Problems in Nuclear Engineering
Credit hours to be arranged.
Individual studies and/or experimental investigations of problems of current interest in nuclear engineering.

NRE 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding graduate teaching assistantships.

NRE 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding graduate research assistantships.

NRE 9000. Doctoral Thesis
Credit hours to be arranged.

HEALTH PHYSICS

HP 6403. Radiological Health I
3-0-3. Prerequisite: MATH 2403.
Applied nuclear and atomic physics, radioactive decay, radiation interactions, radiation dosimetry and safety guidelines, instrumentation, radiation protection, and basics of criticality safety.

HP 6404. Radiological Health II
3-0-3. Prerequisite: HP 6403.
Internal dosimetry, internal radiation protection, ALARA, evolution of protective measures, radiological emergency response.

HP 6416. Applied Radiological Health Laboratory
2-3-3. Prerequisites: HP 6404 and (HP 6757 or NRE 6757).
Advanced laboratory course in radiochemical and instrumental analysis. Practical radiation/radioactivity monitoring problems in nuclear facilities and environmental surveillance.

HP 6506. Operational Health Physics
3-0-3. Prerequisite: HP 6404.
Radiation sources, radiological safety practices and procedures for nuclear facilities and the impact of radiological safety in the design of such facilities.

HP 6601. Industrial Hygiene
3-0-3. Prerequisite: MATH 2403.
Chemical, physical, biological, and ergonomic exposures. Occupational environment regulations. Application of scientific and engineering principles to hazard evaluation and general occupational health control measures.

HP 6755. Radiological Assessment and Waste Management
3-0-3. Prerequisite: HP 6403.
Critical analyses of sources and human exposures, mathematical models for movement through the biosphere, environmental transport, and exposure for nuclear facilities and waste disposal processing. Crosslisted with NRE 6755.

HP 6756. Radiation Physics
3-0-3.
Characteristics of atomic and nuclear radiation, transition probabilities, radioactivity and isotopes, cross sections, electromagnetic radiation, neutrons, and charged particle interaction with matter. Crosslisted with NRE 6756.

HP 6757. Radiation Detection
2-3-3. Prerequisite: NRE 6756 or HP 6756.
Introduction to the theory and application of radiation detectors, measurement methods, signal processing, and data analysis. Crosslisted with NRE 6757.

HP 6758. Numerical Methods in Mechanical Engineering
3-0-3.
Numerical methods for solution of engineering problems; initial, eigenvalue aand boundary value problems; computational stability for ordinary and linear partial differential equations. Crosslisted with ME and NRE 6758.

HP 7000. Master's Thesis
Credit hours to be arranged.

HP 7757. Teaching Practicum
1-6-3.
Supervised teaching for doctoral students. Teaching techniques, course and curriculum design, student evaluation methods and criteria. Students may, in some instances, prepare and present lectures. Crosslisted with NRE and ME 7757.

HP 8011,-2. Seminars in Health Physics
1-0-1, each.
Seminars involving current research projects presented by graduate students, faculty, and invited speakers.

HP 8801,-2,-3,-4,-5,-6. Special Topics in Health Physics
1, 2, 3, 4, 5, 6 credit hours, respectively.
Special topic offerings of current interest in health physics not included in regular courses.

HP 8901,-2,-3,-4,-5,-6. Special Problems in Health Physics
Credit hours to be arranged.
Individual studies and/or experimental investigations of problems of current interest in health physics.

HP 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding a graduate teaching assistantship.

HP 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding a graduate research assistantship.

HP 9000. Doctoral Thesis
Credit hours to be arranged.

School of Textile and Fiber Engineering

School of Textile and Fiber Engineering
Established in 1897
Location: Manufacturing-Related Disciplines Complex (MRDC)
Telephone: (404) 894-2490
Website: www.tfe.gatech.edu

Chair and Professor–Fred L. Cook; *Associate Chair for Graduate Studies and Research and Professor*–Sundaresan Jayaraman; *Professors*–Satish Kumar, Malcolm B. Polk, Behnam Pourdeyhimi, Wayne C. Tincher; *Associate Professors*–Wallace W. Carr, J. Lewis Dorrity, Stephen Michielsen, Youjiang Wang; *Assistant Professors*–Haskell W. Beckham, Karl I. Jacob, Mary Lynn Realff; *Adjunct Professors*–Agaram S. Abhiraman, George Vachtsevanos; *Research Scientists*–Abraham M. Kotliar, Radhakrishnaiah Parachuru.

General Information

Textiles, one of humankind's oldest commercial ventures, continues to find new applications in the modern world. Engineered fibrous structures have many uses in our everyday lives and are playing critical roles in novel complex systems in the fields of space, aeronautics, automotives, medicine, safety, environmental control, sports,transportation, and construction.

Multidisciplinary by nature, the field of textile and fiber engineering encompasses, among other areas: the synthesis of polymers by nature and humankind; fiber fabrication processes; assembling of fibers into one-, two-, and three-dimensional structures; modification of structural properties through dyeing, finishing, and coating; and measurement of complex aesthetic and mechanical properties of fiber-based systems. New polymers and fibers, new methods of assembling fibers into useful products, and new engineering applications of fibers are continually developing.

The School of Textile and Fiber Engineering prepares students for rewarding careers in the polymer-fiber-textile-fabricated products industrial complex. Graduates obtain positions in plant and design engineering, manufacturing, technical service, sales, product and process development, research, quality control, and corporate management. They participate in the design, development, manufacturing, and marketing of a broad range of fiber-based and associated products. Many hold key decision-making positions at a young age.

The textile industry is by far the largest manufacturing industry and employer in the Southeast. If apparel, fiber, and other associated segments are included, the textile-based industry is the largest in the United States, representing one out of every eight manufacturing jobs (more than 2 million total). The industry's needs for university graduates each year far exceed the number available.

Undergraduate Program

Three study programs are available, leading to the degrees Bachelor of Science in Textile and Fiber Engineering, Bachelor of Science in Polymer and Textile Chemistry, and Bachelor of Science in Textile Enterprise Management. Students may pursue each degree in a regular four-year program or the five-year cooperative plan.

Because of the multidisciplinary nature of polymers, fibers, and textiles, the curricula stress broad backgrounds. Emphasis in the freshman and sophomore years is on mathematics, chemistry, and physics, and in the junior and senior years on materials science, polymer and textile chemistry and engineering, applied mechanics, business administration, and application of each field to the broad range of problems encountered in the industrial complex. All three programs allow the student to select courses from a range of general and technical electives.

In place of many conventional laboratory sessions, students participate in novel textile manufacturing laboratories. Every participant is exposed to all facets of the technical and business environments, with the emphasis on interdisciplinary team problem solving, investigation and development of industry case studies, total quality processes, continuous quality improvement, and industrial partnerships.

Since most of the polymer/fiber/textile course work is concentrated in the last two years of the programs, students from junior and community colleges can readily transfer into the School of Textile and Fiber Engineering. The Regents' Engineering Transfer Program (RETP) facilitates such transfers.

Minor Programs for Nontextile Majors

A substantial number of students graduating in other nontextile majors at Georgia Tech enter the textile and allied industries. A minor and a certificate program have been implemented in Textile Manufacturing. The certificate program is designed to impart basic understanding of textile materials, as well as understanding of dry and wet textile manufacturing processes. The minor in Textile Manufacturing is designed to provide more indepth understanding of textile materials, and wet and dry textile manufacturing processes through a combination of required and elective courses. Attainment of the certificate requires 12 credit hours of specified courses. Attainment of a minor requires 12 credit hours of specified courses and 6 hours of electives from a specified list of courses. Both the certificate and the minor programs draw on the courses taught for the 3 undergraduate textile degree programs. Requirements for the minor and the certificate programs are available in the School's main office. The director of Student Affairs acts as the advisor for these certificate and minor programs.

Bachelor of Science in Textile and Fiber Engineering (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
MATH 1501	CALCULUS I	4
CHEM 1211	GENERAL CHEMISTRY	4
ENGL 1101	COMPOSITION I	3
CS 1301	COMPUTER SCIENCE I	3
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS		16

First Year - Spring Semester

Course Number/Name		*Hours*
MATH 1502	CALCULUS II	4
CHEM 1311	INORGANIC CHEMISTRY I	3
CHEM 1312	INORGANIC CHEM LAB	1
ENGL 1102	COMPOSITION II	3
PHYS 2211	PHYSICS I	4
TFE 1001	INTRO. TO TFE	1
TOTAL SEMESTER HOURS		16

Second Year - Fall Semester

Course Number/Name		*Hours*
MATH 2401	CALCULUS III	4
PHYS 2212	PHYSICS II	4
CEE 2020	STATICS & DYNAMICS	3
TFE 2001	FIBER SCIENCE	3
HIST 2111 or 2112 or POL 1101 or	PUBP 3000 or INTA 1200	3
TOTAL SEMESTER HOURS		17

Second Year - Spring Semester

Course Number/Name		*Hours*
MATH 2403	DIFF. EQUATIONS	4
MSE 2001	PRINC. & APPS. OF ENGR MATERIALS	3
CEE 3030	STRENGTH OF MATERIALS	3
ME 3340	FLUID MECHANICS	3
ECON 2100	ECONOMICS & POLICY	3
TOTAL SEMESTER HOURS		16

Third Year - Fall Semester

Course Number/Name		*Hours*
TFE 3001	DYNAMICS OF YARN & FIBER	4
ECE 3710	CIRCUITS	2
MATH/ISYE 3770	STATISTICS & APPLICATIONS	3
ISYE 3025	ENGINEERING ECONOMY	1
ME 3322	THERMODYNAMICS	3
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		16

Third Year - Spring Semester

Course Number/Name		*Hours*
TFE 3025	CHEMICAL PROCESSING	3
TFE 3026	TEX. CHEM LAB	1
TFE 3090	TEX. MFG. LAB I	1
TFE 3003	TEX. PROCESSING	3
TFE 3005	OPERATIONS & MGT. METHOD	3
ECE 3741	ECE LAB	1
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		15

Fourth Year - Fall Semester

Course Number/Name		*Hours*
TFE 4041	TFE DESIGN I	3
TFE 4773	INTRO. TO POLYMERS	3
TFE 4002	PROP. OF FIBROUS MATERIALS	3
TFE 4093	TEXTILES TESTING LAB	1
TFE 4043	ETHICS & SAFETY	1
ECE 3301	ENERGY CONVERSION	2
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		16

Fourth Year - Spring Semester

Course Number/Name		*Hours*
TFE 4042	TFE DESIGN II	3
TFE 4761	INDUSTRIAL & MFG. CONTROLS	4
TFE 4776	POLYMER SCI. & ENG'R. II	3
TFE 4004	FIBER FORMATION	3
TFE ELECTIVE		1
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		17

TOTAL PROGRAM HOURS = 127 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Electives

Humanities/Social Sciences/Modern Languages Electives

A total of 12 credit hours of humanities and 12 credit hours of social sciences are required. See pages 33-34 for a list of acceptable courses. The courses selected to fulfill the humanities and social sciences requirements must provide both breadth and depth and should not be a selection of unrelated introductory courses. The humanities and social sciences courses taken must include 6 credit hours at the 3000 or 4000 level. This requirement can be satisfied with 2 humanities courses, 2 social sciences courses, or 1 of each. Students should see their academic advisor for course sequences that satisfy the depth requirement. To satisfy the state requirement regarding course work on the history and constitutions of the U.S. and Georgia, students must complete one of the following courses: HIST 2111, HIST 2112, POL 1101, PUBP 3000 or INTA 1200.

Technical Electives

Two hours of textile electives must be approved by the School.

Bachelor of Science in Polymer and Textile Chemistry (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
MATH 1501	CALCULUS I	4
ENGL 1101	COMPOSITION I	3
CHEM 1211	GENERAL CHEMISTRY	4
CS 1301	COMPUTER SCIENCE I	3
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS		16

First Year - Spring Semester

Course Number/Name		*Hours*
MATH 1502	CALCULUS II	4
ENGL 1102	COMPOSITION II	3
CHEM 1311	INORGANIC CHEMISTRY I	3
CHEM 1312	INORGANIC LAB.	1
PHYS 2211	PHYSICS I	4
TFE 1001	INTRO. TO TFE	1
TOTAL SEMESTER HOURS		16

Second Year - Fall Semester

Course Number/Name		*Hours*
MATH 2401	CALCULUS III	4
CHEM 2311	ORGANIC CHEMISTRY I	3
PHYS 2212	PHYSICS II	4
TFE 2002	FIBER STRUCT. & PROP.	2
HIST 2111 or 2112 or POL 1101 or PUBP 3000	or INTA 1200	3
TOTAL SEMESTER HOURS		16

Second Year - Spring Semester

Course Number/Name		*Hours*
MATH 2403	DIFF. EQUATIONS	4
CHEM 2312	ORGANIC CHEMISTRY II	3
CHEM 2381	SYNTHESIS LAB I	2
TFE 2100	YARN & FIBER MFG	3
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		15

Third Year - Fall Semester

Course Number/Name		*Hours*
TFE 3011	TEXTILE CHEM I	3
CHEM 3411	PHYSICAL CHEM I	3
CHEM 3481	PHYSICAL CHEM LAB I	2
MATH/ISYE 3770	STATISTICS & APPLICATIONS	3
ECON 2100	ECONOMICS & POLICY	3
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		17

Third Year - Spring Semester

Course Number/Name		*Hours*
TFE 3012	TEXTILE CHEMISTRY II	3
TFE 3026	TEXTILE CHEMISTRY LAB	1
TFE 3090	TEX. MFG. LAB. I	1
TFE 3003	TEX. PROCESSING	3
CHEM 3281	ANALYSIS FOR ENGINEERS	4
TFE 3005	OPERATIONS & MGT. METHODS	3
TOTAL SEMESTER HOURS		15

Fourth Year - Fall Semester

Course Number/Name		*Hours*
TFE 4775	POLYMER SCI & ENG'R I	3
TFE 4031	TEXTILE MATERIALS	2
TFE 4093	TESTING LAB	1
TFE 4043	ETHICS & SAFETY	1
CHEM 4341	APP. SPECTROSCOPY	3
ENVE ELECTIVE		3
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		16

Fourth Year - Spring Semester

Course Number/Name		*Hours*
TFE 4013	CHEM. OF POLYMER SORPTION	3
TFE 4014	SCIENCE OF COLOR	2
TFE 4004	FIBER FORMATION	3
TFE 4776	POLYMER SCI. & ENG'R. II	3
SOCIAL SCIENCE ELECTIVE		3
TFE 4091	TEXTILE MFG. LAB II	1
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 124 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Electives

Humanities/Social Sciences/Modern Languages Electives

A total of 12 credit hours of humanities and 12 credit hours of social sciences are required. See pages 33-34 for a list of acceptable courses. The courses selected to fulfill the humanities and social sciences requirements must provide both breadth and depth and should not be a selection of unrelated introductory courses. The humanities and social sciences courses taken must include 6 credit hours at the 3000 or 4000 level. This requirement can be satisfied with 2 humanities courses, 2 social sciences courses, or 1 of each. Students should see their academic advisor for course sequences that satisfy the depth requirement. To satisfy the state requirement regarding course work on the history and constitutions of the U.S. and Georgia, students must complete one of the following courses: HIST 2111, HIST 2112, POL 1101, PUBP 3000 or INTA 1200.

Technical Electives

One course is designated as an environmental elective. This course must be approved by the School.

Bachelor of Science in Textile Enterprise Management (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
MATH 1501	CALCULUS I	4
ENGL 1101	COMPOSITION 1	3
CHEM 1211	GENERAL CHEMISTRY	4
CS 1301	COMPUTER SCIENCE I	3
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS		16

First Year - Spring Semester

Course Number/Name		*Hours*
MATH 1502	CALCULUS II	4
ENGL 1102	COMPOSITION II	3
PHYS 2211	PHYSICS I	4
ECON 2106	MICROECONOMICS	3
TFE 1001	INTRO. TO TFE	1
TOTAL SEMESTER HOURS		15

Second Year - Fall Semester

Course Number/Name		*Hours*
TFE 2001	INTRO. TO FIBER SCIENCE	3
ACCT 2101	ACCOUNTING I	3
ECON 2105	MACROECONOMICS	3
CHEM 1311	INORGANIC CHEMISTRY	3
CHEM 1312	INORGANIC CHEMISTRY LAB	1
HIST 2111 or 2112 or POL 1101 or	PUPB 3000 or INTA 1200	3
TOTAL SEMESTER HOURS		16

Second Year - Spring Semester

Course Number/Name		*Hours*
TFE 2100	YARN & FIBER MFG.	3
ACCT 2102	ACCOUNTING II	3
ECON 3150	ECON. MODELING	3
MGT 3150	PRINCIPLES OF MANAGEMENT	3
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		15

Third Year - Fall Semester

Course Number/Name		*Hours*
TFE ELECTIVE		2
MGT 3062	FINANCIAL MANAGEMENT	3
MGT 3300	MARKETING MANAGEMENT	3
MATH/ISYE 3770	STATISTICS & APPLICATIONS	3
HUMANITIES ELECTIVE		3
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		17

Third Year - Spring Semester

Course Number/Name		*Hours*
TFE 3005	OPERATIONS & MGT. METHODS	3
TFE 3025	CHEM PROCESSING	3
TFE 3026	TEXTILE CHEMISTRY LAB	1
TFE 3090	TEXTILE MFT LAB I	1
MGT 3101	ORGANIZATIONAL BEHAVIOR	3
MGT ELECTIVE		3
TOTAL SEMESTER HOURS		14

Fourth Year - Fall Semester

Course Number/Name		*Hours*
TFE 4031	TEXTILE MATERIALS	2
TFE 4043	ETHICS & SAFETY	1
TFE 4093	TESTING LAB	1
TFE ELECTIVE		2
MGT 3610	MGT. RESOURCES	3
MGT. ELECTIVE		3
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		15

Fourth Year - Spring Semester

Course Number/Name		*Hours*
TFE 4091	TEXTILE MFG. LAB II	1
TFE 4092	TEXTILE MFG.INTERNSHIP	1
TFE ELECTIVE		2
ISYE 3025	ENG'R. ECONOMY	1
MGT ELECTIVE		3
ENVE ELECTIVE		3
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		14

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Electives

Management Electives

Nine hours are designated as management electives. These should be within one of the following concentrations: accounting, finance, international management, information technology management, or marketing. These courses must not be in the required curriculum and must be approved by the School.

Humanities/Social Sciences/Modern Languages Electives

A total of 12 credit hours of humanities and 12 credit hours of social sciences are required. See pages 33-34 for a list of acceptable courses. The courses selected to fulfill the humanities and social sciences requirements must provide both breadth and depth and should not be a selection of unrelated introductory courses. The humanities and social sciences courses taken must include 6 credit hours at the 3000 or 4000 level. This requirement can be satisfied with 2 humanities courses, 2 social sciences courses, or 1 of each. Students should see their academic advisor for course sequences that satisfy the depth requirement. To satisfy the state requirement regarding course work on the history and constitutions of the U.S. and Georgia, students must complete one of the following courses: HIST 2111, HIST 2112, POL 1101, PUBP 3000 or INTA 1200.

Technical Electives

Six hours of textile electives must be approved by the School. In addition, one course is designated as an environmental elective. This course must be approved by the School.

Graduate Programs

The School of Textile and Fiber Engineering offers graduate programs leading to the degrees Master of Science in Textile and Fiber Engineering, Master of Science in Textile and Fiber Chemistry, Master of Science in Polymers-Polymer Materials Science or Polymer Chemistry Track, Master of Science Undesignated, and Doctor of Philosophy in one of the following tracks: Textile and Fiber Engineering; Textile and Fiber Chemistry; Polymer Materials Science or Polymer Chemistry. Students holding an undergraduate degree in any one of several fields of science or engineering may qualify for admission. A textile-specific undergraduate degree is not a requirement for admission. Each student pursues an individually structured program. The School participates in the Graduate Course Option Program (see p.30).

The graduate course offerings encompass advanced study and research in polymer synthesis, mechanics of structured fibrous materials, process dynamics, dye/chemical transport, heat transfer, fiber formation-structure-property relationships, properties of fibrous materials, polymer flow, environmental issues, sports materials, computer process control, composites, and nonwovens. The School has a variety of active research programs in which students participate.

Facilities

The School of Textile and Fiber Engineering is centered in the Manufacturing-Related Disciplines Complex-I Building, an ultramodern classroom and laboratory facility. Equipment representing most major types of fiber and textile processing is also available. Well equipped laboratories are also available for the synthesis, chemical, and physical characterization of polymers, fibers, and fibrous assemblies. Specialized equipment is available for, among others, fabric flammability studies, polymer environmental stability experiments, polymer synthesis, fiber-reinforced composite formation and testing, carbon and other high-performance fiber development, electrostatic chemical deposition, sports physiology, energy conservation, and water pollution studies. Machine shop and instrumentation facilities with supporting technicians are also available.

Multidisciplinary Programs

See table on p. 122.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

TEXTILE AND FIBER ENGINEERING

TFE 1001. Introduction to the Fiber/Textile/Fabricated Products Enterprises
0-3-1.
Introduction to, and overview of, the breadth/depth of the fiber/textile/fabricated products manufacturing complex, its infrastructure, resources, opportunities, and career paths.

TFE 1100. Fundamentals of Textile Science
2-0-2. Prerequisites: CHEM 1211 and PHYS 2211.
Introduction to the materials, structure, properties, and formation processes of fibers and textile products.

TFE 2001. Introduction to Fiber Science
3-0-3. Prerequisite: CHEM 1211.
The chemistry, micro and macro structure of fibers will be examined. Structure-property relationships will be covered, and various properties of both natural and synthetic fibers will be discussed.

TFE 2002. Fiber Structures and Properties
2-0-2. Prerequisite: CHEM 1211; Co-requisite: CHEM 2311.
The micro and macro structures of fibers are examined. Structure-property relationships will be covered, and various properties of both natural and synthetic fibers will be discussed.

TFE 2100. Yarn and Fabric Manufacturing
3-0-3. Prerequisites: TFE 2001 or TFE 2002.
Review of the principles of yarn formation and weaving processes. Review of the factors affecting quality and productivity in yarn and fabric formation. Analysis of the merits and limitations of the latest manufacturing technologies.

TFE 3001. Dynamics of Yarn and Fabric Formation
4-0-4. Prerequisite: TFE 2001.
Features of modern weaving, weaving preparatory, and spinning equipment, and their interaction with fibrous materials are discussed at length.

TFE 3003. Fundamentals of Transport in Textile Processes and Structures
2-3-3. Prerequisites: (MATH 2403 or MATH 2413) and (ME 3322 or CHEM 3411).
An introduction to unit operations of chemical engineering emphasizing applications to fibers and textiles.

TFE 3005. Textile Operations/Management Methods
3-0-3. Prerequisites: TFE 3001 or TFE 2100.
Principles and applications of production/operations management to the textile enterprise including process flow analysis, production planning and scheduling, optimization, quality management, and facilities planning.

TFE 3011. Textile Chemistry I: Preparation and Finishing
3-0-3. Prerequisites: TFE 2002 and CHEM 2312.
Structure, purification, and mechanical and chemical finishing of natural and synthetic fibers with emphasis on the relationship of fiber structure and response of textiles to these processes.

TFE 3012. Textile Chemistry II: Dyeing and Printing
3-0-3. Prerequisites: TFE 2002 and CHEM 2312.
The dyeing and printing of textile materials with emphasis on the relationship of fiber structures and response of textiles to these processes.

TFE 3025. Chemical Processing of Textile Materials
3-0-3. Prerequisite: TFE 2001.
The chemical, thermal, and mechanical processes used in the preparation, coloration, and finishing of textile structures.

TFE 3026. Textile Chemistry Laboratory
0-3-1. Prerequisites: TFE 2001 or TFE 2002; Co-requisite: TFE 3012 or TFE 3025.
Laboratory course in preparation, coloration, and finishing of textiles.

TFE 3090. Textile Manufacturing Laboratory I
0-3-1. Prerequisites: TFE 2001 or TFE 2002.
Review of the typical production calculations involved in yarn and fabric manufacturing. Analysis of the shop-floor problems encountered in yarn and fabric production.

TFE 4002. Mechanics and Physical Properties of Fibrous Materials
3-0-3. Prerequisites: TFE 3001 and (MATH 3770 or ISYE 3770).
Mechanics of yarns, fabrics, and other flexible structures, including yarn and fabric geometry, response to tensile and bending deformations, and fabric shear and drape.

TFE 4004. Fiber Formation Principles
3-0-3. Prerequisites: TFE 3003 and (CHE 4771 or TFE 4771 or CHEM 4771 or CHE 4772 or TFE 4772 or CHEM 4772)
Discussion of the principles of fiber formation from polymers including rheology, mechanics, energetics, phase transitions, and polymer structure. High-performance fibers are also discussed.

TFE 4013. Physical Chemistry of Polymer Sorption
3-0-3. Prerequisites: CHEM 3411 and TFE 3012 and TFE 3003 and (TFE 4771 or CHE 4771 or CHEM 4771)
Detailed description of sorption by polymers, emphasizing physio-chemical laws of transport of chromophores through solution, interfaces, and solid-state.

TFE 4014. Science of Color
1-3-2. Prerequisites: CHEM 1312 and PHYS 2212.
The physical, chemical, and biological principles involved in the perception, measurement, specification of color and applications in industry.

TFE 4031. Properties of Textile Materials
2-0-2. Prerequisites: TFE 2100 and (MATH 3770 or ISYE 3770).
Mechanics of yarns, fabrics, and other flexible structures, including yarn and fabric geometry, response to tensile and bending deformations, and fabric shear and drape.

TFE 4041. Textile and Fiber Engineering Design I
2-3-3. Prerequisites: TFE 3001 and Co-requisite: TFE 4093.
A design course covering the principles of concurrent product/process design and development. Team-based projects will explore product/process design and development in textiles.

TFE 4042. Textile and Fiber Engineering Design II
0-9-3. Prerequisite: TFE 4041.
A team problem-solving approach is used to work on a project developed in cooperation with a textile company. Weekly communications, both oral and written, are required.

TFE 4043. Safety and Ethics
1-0-1.
Principles of ethics and safety are presented. The legal requirements for chemical usage and worker safety are discussed.

TFE 4091. Textile Manufacturing Laboratory II
0-3-1. Prerequisites: TFE 2100 and TFE 3090 and TFE 4031.
Application of statistical tools and standard test methods for quality-related problem solving in yarn and fabric manufacturing processes.

TFE 4092. Textile Management Internship
0-3-1.
Students will participate in an internship at an industrial site where they will receive management training and be involved with corporate activities such as sales, marketing, management, and human resources.

TFE 4093. Textile Testing Laboratory
0-3-1. Prerequisites: (TFE 2001 or TFE 2002) and (TFE 3001 or TFE 2100) and (MATH 3770 or ISYE 3770) and TFE 4002 and TFE 4031.
Testing and data analysis of textiles including testing of fibers, yarns, fabrics, and carpets.

TFE 4101. Carpet Technology
2-0-2. Prerequisites: (TFE 2100 or TFE 3001) and TFE 3090.
A study of materials and production systems used in carpet manufacturing. Carpet structures and performance characterisucs and industry structure and markets are examined.

TFE 4102. Nonwovens Technology
2-0-2. Prerequisites: TFE 3090 and (TFE 2100 or TFE 3001).
A review of the principles of nonwoven processes. Review of the machinery requirements for the most commonly produced structures is followed by an analysis of the structure-property relationships of nonwoven fabrics.

TFE 4103. Knitting Technology
2-0-2. Prerequisites: TFE 3090 and (TFE 2100 or TFE 3001).
An overview of warp and weft knitting processes. Review of the machinery requirements and analysis of structure-property relationships of knit fabrics.

TFE 4104. Advanced Woven Fabrics
2-0-2. Prerequisites: TFE 2100 or TFE 3001.
Pattern design, manufacturing, and applications of different woven structures including jacquard, leno, terry, three-dimensional, and rug weaves.

TFE 4105. Apparel Technology
2-0-2. Prerequisites: TFE 2001 or TFE 2002.
Apparel engineering and manufacturing, from planning and receipt of raw materials to the distribution of finished garments.

TFE 4761. Industrial Controls and Manufacturing
3-3-4.
Students are introduced to industrial controls and the fundamentals of manufacturing with hands-on experience based on lab projects using industry software and hardware for communications and control. Crosslisted with ECE 4761.

TFE 4775. Polymer Science and Engineering I: Formation and Properties
3-0-3. Prerequisites: CHEM 2312 and CHEM 3411.
An introduction to the chemistry, structure, and formation of polymers, physical states and transitions, physical and mechanical properties of polymer fluids and solids. Crosslisted with CHE, CHEM, ME, and MSE 4775.

TFE 4776. Polymer Science and Engineering II: Analysis, Processing, and Laboratory
1-6-3. Prerequisites: CHE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or TFE 4775.
Polymer fabrication processes and methods of characterization and identification of polymers are presented. Experiments in polymerization, processing, and property evaluation of polymers. Crosslisted CHE, CHEM, ME, and MSE 4776.

TFE 4777. Introduction to Polymer Science and Engineering
3-0-3. Prerequisite: MATH 2403.
An introduction to the structure and formation of polymers, physical states and transitions, physical and mechanical properties of polymer fluids and solids, and processing of polymers. Crosslisted with CHE, ME, and MSE 4777

TFE 4791. Mechanical Behavior of Composites
3-0-3. Prerequisite: ME 3311
Stress-strain behavior of composites, property of matrix and reinforcing materials, mechanics of fiber-reinforced composites, lamina and laminate analysis, and mechanical performance. Crosslisted with AE, CEE, CHE, ME, and MSE 4791

TFE 4793. Composite Materials and Processes
3-0-3.
Basic principles of selection and design of composite materials and their manufacturing and testing. Cost factors. (Laboratory exercises on manufacturing and tests.) Crosslisted with AE, CEE, CHE, ME, and MSE 4793.

TFE 4794. Composite Materials and Manufacturing
2-3-3.
Basic principles of selection and design of composite materials and their manufacturing and testing. Cost factors. Laboratory exercises on manufacturing and tests. Crosslisted with AE, CEE, CHE, ME, and MSE 4794.

TFE 4801,-2,-3,-4. Special Topics
1, 2, 3, 4, credit hours, respectively.

TFE 4901,-2. Special Problems
Credit hours to be arranged

TFE 6100. Mechanics of Fibrous Materials
3-0-3.
Discussion of deformation of anisotropic fibrous materials; anisotropy and critical phenomena in the mechanical behavior of fibrous materials; models for viscoelastic behavior of fibrous materials.

TFE 6101. Dynamics of Textile Processing I: Dry Processing
4-0-4. Prerequisite: MATH 2403.
Features of modern weaving, weaving preparatory, and spinning equipment, and their interaction with fibrous materials are discussed at length.

TFE 6200. Industrial Chemical Processes
3-0-3. Prerequisite: CHEM 2312.
The industrial chemical processes for the production of chemicals, monomers, and textile auxiliaries are covered. Chemical textile auxiliaries are discussed in relation to theory and applications.

TFE 6201. Dye Synthesis
3-0-3.
The chemistry of the synthesis and structures of dyes is covered. Color of dyes is discussed in relation to structure and molecular orbital theory.

TFE 6202. Physical Chemistry of Polymer Sorption
3-0-3. Prerequisites: CHEM 3411 and TFE 3003 and TFE 4771.
Detailed description of sorption by polymers, emphasizing physio-chemical laws of transport of chromophores through solution, interfaces, and solid-state.

TFE 6301. Natural Polymers
3-0-3.
The structures and properties of natural products are presented. Production of cellulose and proteins is discussed.

TFE 6750. Preparation and Reactions of Polymers
3-0-3. Prerequisites: CHE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or TFE 4775.
A detailed treatment of the reactions involved in the synthesis of both man-made and natural polymers, including preparation and degradative reactions of polymer systems. Crosslisted with CHE and CHEM 6750.

TFE 6751. Physical Chemistry of Polymer Solutions
3-0-3. Prerequisites: CHE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or TFE 4775 or ME 4777 or MSE 4777 or TFE 4777 and CHEM 3411.
Study of polymer solutions, polymer miscibility, adsorptions, sorptions, plasticization, molecular weights, molecular weight distributions, and interfacial phenomena using thermodynamics and statistical mechanics. Crosslisted with CHE, CHEM, and MSE 6751.

TFE 6752. Polymer Characterization
3-3-4. Prerequisites: CHE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or TFE 4775 or ME 4777 or MSE 4777 or TFE 4777 and CHEM 3411.
This course introduces the student to surface, near-surface, and structural methods of polymer chatacterization. Specialized techniques critical to physical structure are emphasized. Crosslisted with CHE, CHEM, and MSE 6752.

TFE 6755. Theoretical Chemistry of Polymers
3-0-3. Prerequisites: CHEM 6471 or CHE 6751 or CHEM 6751 or MSE 6751 or TFE 6751.
Thermodynamics and microscopic dynamics of polymers. Fundamental concepts, including scaling concepts, governing anisotropy of polarizability, phase transitions, morphology, time-dependent correlations, etc. are discussed. Crosslisted with CHEM and MSE 6755.

TFE 6759. Materials in Environmentally Conscious Design and Manufacturing
3-0-3.
Covers the environmental impact of materials choices and quantitative measure of life-cycle assessment and environmental burden. The Natural Step philosophy will be used as a model for the overall approach. Crosslisted with ME and MSE 6759.

TFE 6768. Polymer Structure, Physical Properties, and Characterization
3-0-3. Prerequisites: CHE 4776 or CHEM 4776 or ME 4776 or MSE 4776 or TFE 4776.
Formulations and analysis of molecular and phenomenological models of elastic and viscoelastic behavior, development and description of structure, and fundamental aspects of structure-property relations. Crosslisted with MSE, CHE, and ME 6768.

TFE 6778. Introduction to Biomaterials
3-0-3.
Introduction to a variety of biomaterials and their biomedical applications. Crosslisted with CHE, ME, and BMED 6778.

TFE 6795. Mathematical, Statistical, and Computational Techniques in Materials Science
3-0-3.
Emphasizes the fundamental physical, analytical, and mathematical techniques commonly encountered in materials

engineering including stress and strain, crystallographic and orientation transformations, X-ray, TEM, and solid-state concepts. Crosslisted with MSE and ME 6795.

TFE 6796. Structure-Property Relationships in Materials
3-0-3.
Introduction to the multiscale structure effects on material properties. For MSE students the course will prepare students for future in-depth courses. For non-MSE students the course will provide a background in materials and may serve as part of the program of study for a minor in materials. Crosslisted with ME and MSE 6796.

TFE 6797. Thermodynamics and Kinetics of Micro-structural Evolution
3-0-3.
The reduction of chemical-free energy, strain energy, and interfacial energy control the kinetics of diffusional transformations. These factors are explored from the point of view of processing and stability of the microstructure during service. Crosslisted with MSE and ME 6797.

TFE 6998. Safety and Ethics
1-0-1.
Principles of ethics and safety are presented. The legal requirements for chemical usage and worker safety are discussed.

TFE 6999. Textile and Fiber Engineering Graduate Research Colloquium
1-0-1.
Graduate students discuss their research work and special topics in a structured setting with their research groups and research advisors.

TFE 7000. Master's Thesis
Credit hours to be arranged

TFE 7100. Advanced Principles of Fiber Formation, Structure and Properties
3-0-3. Prerequisite(s): MATH 2403 and (CHE 4772 or TFE 4772).
Principles and theories of structure, properties, and formation of fibers; structural models, physical properties, rheology, mechanics, energetics, and phase transitions in fiber formation processes.

TFE 7771. Mechanics of Polymer Solids and Fluids
3-0-3.
Continuum of solids and fluids; mechanics of deformation of anisotropic polymers; yield, breaking, and fatigue; non-Newtonian viscous and viscoelastic behavior of polymer fluids. Crosslisted with CHE, ME, and MSE 7771.

TFE 7791. Damage, Failure, and Durability of Composite Material
3-0-3. Prerequisites: AE 4791 or CEE 4791 or CHE 4791 or ME 4791 or MSE 4791 or TFE 4791.
Provides knowledge of the fundamental concepts and methods related to analysis and assessment of damage, failure, and durability of composite material. Crosslisted with AE, CHE, CEE, ME, and MSE 7791.

TFE 7792. Advanced Mechanics of Composites
3-0-3. Prerequisites: AE 4791 or CEE 4791 or CHE 4791 or ME 4791 or MSE 4791 or TFE 4791
Anisotropic elasticity, failure theories, hygrothermal behavior, 3-D analysis of laminates, thick laminates, free-edge effects, stress concentrations, joints, creep and fracture of composites, and advanced topics. Crosslisted with AE, CEE, CHE, ME, and MSE 7792.

TFE 7793. Manufacturing of Composites
3-0-3.
Major manufacturing techniques of metal-, ceramic-, and polymer-matrix composites. Modeling of processes with emphasis on fundamental mechanisms and effects. Crosslisted with AE, CEE, CHE, ME, and MSE 7793.

TFE 7999. Preparation for Doctoral Qualifying Examinations
1-0-1.

TFE 8001,-2. Textile and Fiber Engineering Seminar
1-0-1, each.
Graduate students discuss their research work. Invited speakers with diverse backgrounds describe their experiences, entrepreneurial ventures, and research challenges.

TFE 8801,-2,-3,-4. Special Topics
1, 2, 3, 4 credit hours, respectively.
Graduate-level special topic offerings of current interest in polymers, fibers, and textiles not included in regular courses.

TFE 8813. Special Topics
2-3-3.
Graduate-level special topic offerings of current interest in polymers, fibers, and textiles not included in regular courses.

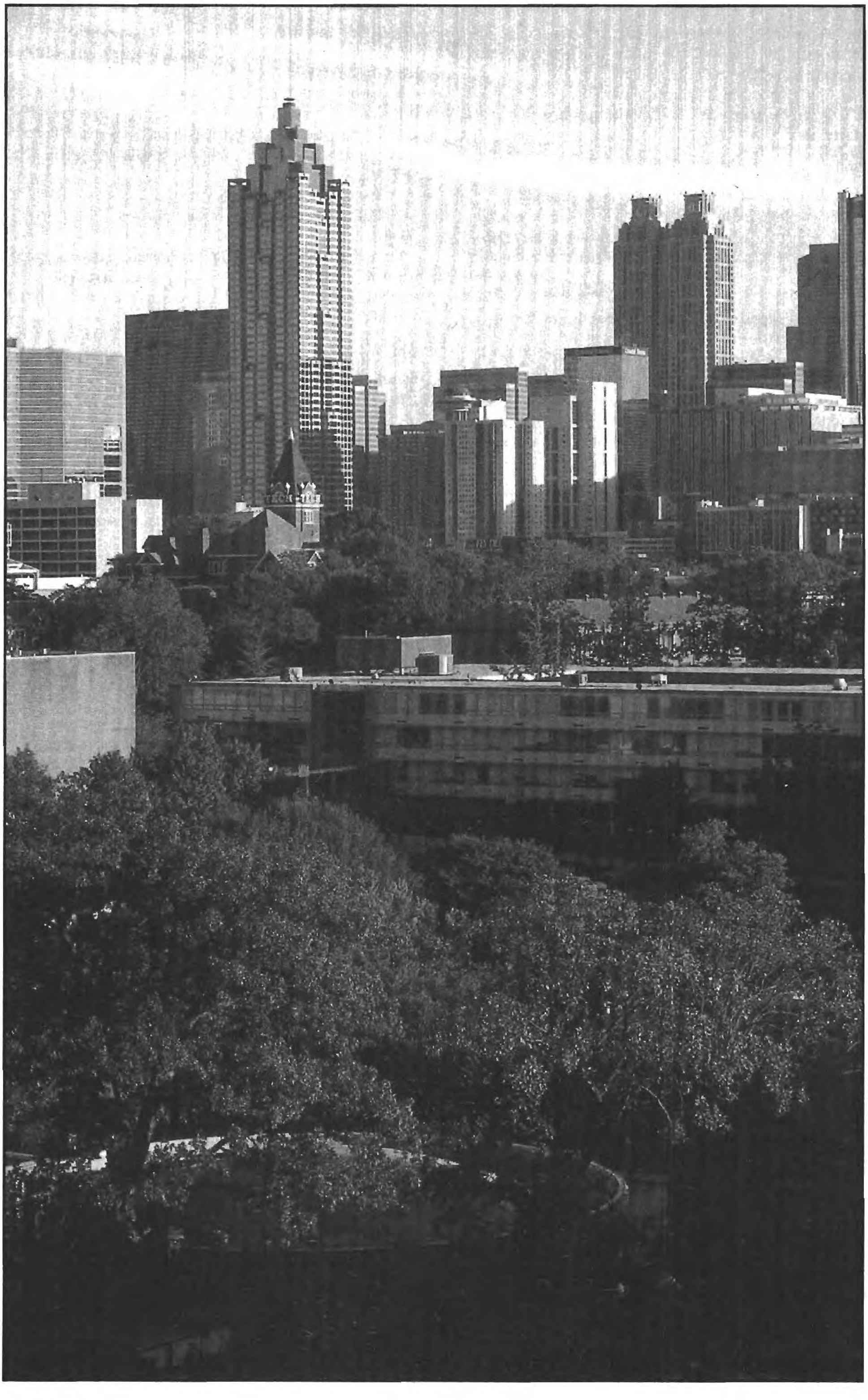
TFE 8814. Special Topics
3-3-4.
Graduate-level special topic offerings of current interest in polymers, fibers, and textiles not included in regular courses.

TFE 8900,-1,-2. Special Problems
Credit hours to be arranged.
Graduate-level special problems involving research investigations in the fields of polymers, fibers, and/or textiles.

TFE 8997. Teaching Assistantship
Credit hours to be arranged.
For students holding a teaching assistantship.

TFE 8998. Research Assistantship
Credit hours to be arranged.
For students holding graduate research assistantships.

TFE 9000. Doctoral Thesis
Credit hours to be arranged.



The Ivan Allen College

WWW.IAC.GATECH.EDU

Interim Dean–Kenneth J. Knoespel;
Interim Associate Dean–Richard P. Barke

General Information

The Ivan Allen College, named after a visionary leader who served as mayor of Atlanta during a time associated with the creation of the "New South," is a unique configuration of six schools and departments as well as Georgia Tech's three ROTC departments. The College was established in 1990 in order to broaden the range of majors available to Tech students. The degree programs, which link the study of the social and human sciences to the world of technology and science, have received broad recognition for preparing students for a wide range of professional careers including leadership in government, business, and technology. Study in these fields also prepares students for advanced study in professional programs ranging from medicine, law, international affairs, and new media to graduate study in the humanities and social sciences. The success of these new programs, which are available to Georgia Tech students, has resulted in a proud, ongoing realization of the close connections between service and progress expressed in Georgia Tech's motto.

The Ivan Allen College offers five undergraduate degrees, five master's degrees, and two doctoral degrees. Detailed descriptions of these programs can be found under the appropriate school headings. In addition to its degree programs, the Ivan Allen College provides all Tech students with instruction in the humanities and social sciences. The College's course offerings and its certificate and minor programs enable students, regardless of major, to broaden their educational experience and to better understand the cultural under-pinnings of their professional and personal lives and the international context in which they live and work.

Getting Started

Freshmen may enter directly into any of the undergraduate programs of the College, or they may enter as Undecided Ivan Allen College (UIAC) students and receive advisement from the Office of the Dean. In any case, the course requirements for the first year of study are virtually identical among all the majors in the College, so it is easy to postpone or change a decision about the major within the first year.

Certificate Programs and Minor Programs

The schools and departments of the Ivan Allen College offer certificates and minor programs in a variety of areas for students who wish to concentrate on course work in areas of particular interest. All certificates require a minimum of 12 semester hours of concentration. Minor programs require at least 18 hours of concentration (at least 12 hours taken at the 3000 level or above.) Faculty advisors in the relevant schools should be consulted for details.

School of Economics

Economics

School of History, Technology, and Society

History
Sociology
Asian Affairs (with International Affairs)
European Affairs (with International Affairs)
African-American Studies (with Literature, Communication, and Culture)

The Sam Nunn School of International Affairs

International Affairs
Asian Affairs (with History, Technology, and Society)
European Affairs (with History, Technology, and Society)

School of Literature, Communication, and Culture

African-American Studies (with History, Technology, and Society)

School of Public Policy

Pre-Law
Political Science
Philosophy, Science, and Technology
Public Policy

Department of Modern Languages

French
German
Spanish
Linguistics
Japanese

Department of Air Force Aerospace Studies

Established in 1946
Location: D. M. Smith Building
Telephone: (404) 894-4175

Department Head and Professor–Col. J.C. Mann; *Assistant Professors*– Capt. Maurice C. Azar, Capt. Eugene M. Burns III, Capt. David W. DeGraaf, Capt. Adam F. Helmbold, Maj. Carlleen Murray.

General Information

The Air Force Reserve Officer Training Corps (AFROTC) program includes two phases. The first two years constitute the General Military Course (G.M.C.) and the last two years, the Professional Officer Course (P.O.C.).

Undergraduate Program

Four-Year Program

Students entering the four-year program enroll in AFROTC courses in the same manner in which they register for other undergraduate courses. A formal application is not required. Students enrolled in the G.M.C. incur no military obligation unless they are on an AFROTC scholarship. Those students desiring to become commissioned officers in the Air Force must compete for entry into the P.O.C., which is normally taken during the last two years of college. In the summer, between the sophomore and junior years, cadets normally attend a four-week field training session conducted at an Air Force base. Students accepted for the P.O.C. become members of the Air Force Reserve and receive a monthly tax-free subsistence allowance of $150 during the academic year.

Two-Year Program

The two-year program and the last two years of the four-year program are identical in academic content. The basic requirement for entry into this program is that the student must have two academic years remaining in school. This may be at the undergraduate or graduate level or a combination of the two. Selection of two-year applicants is predicated upon the same criteria as selection of four-year program cadets. In addition, candidates must successfully complete a five-week field training course at an Air Force base during the summer preceding their enrollment and be recommended to enter the P.O.C. upon their return to campus.

AFROTC College Scholarship Program

AFROTC college scholarships are available on a competitive basis to qualified cadets in the two- and four-year programs. Scholarships cover tuition, matriculation, health services, student activities fees, and books. All scholarship cadets receive a tax-free subsistence allowance of $150 per month during the academic year.

Leadership Laboratory

Leadership laboratory is a separate course requiring two hours per week throughout the cadet's enrollment in AFROTC. It involves a study of Air Force customs and courtesies, drill and ceremony, professional development opportunities in the Air Force, and the life and work of an Air Force junior officer. Students develop their leadership potential in a practical, supervised laboratory, which may include field trips to Air Force installations and presentations by Air Force personnel.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

AIR FORCE AEROSPACE STUDIES

AS 1110. Foundations of the Air Force I
1-0-1. Co-requisite: AS 1111
A survey course designed to introduce students to the U.S. Air Force and Air Force Reserve Officer Training Corps (AFROTC). Topics include officership, professionalism, military customs and courtesies, Air Force core values, officer opportunities and benefits, and an introduction to communication skills.

AS 1111. Leadership Laboratory
0-2-1. Co-requisite: AS 1110.
Introduction to the customs, traditions, and courtesies of the Air Force through drill and ceremonies, guest speakers, physical fitness activities, sports, and base visits.

AS 1120. Foundations of the Air Force II
1-0-1. Co-requisite: AS 1121
A continuation of AS 1110. Topics include foundations and organization of the Air Force, Air Force bases, sister services, and basic communication skills.

AS 1121. Leadership Laboratory
0-2-1. Co-requisite: AS 1120.
Continuation of AS 1111. Emphasis on role and responsibilities of an Air Force junior officer. Air Force customs and courtesies, drill and ceremonies, and introduction to the military environment.

AS 2210. Evolution of U.S. Air and Space Power I
1-0-1. Co-requisite: AS 2211.
An introduction to the study of air power and how technology has affected the growth of air power. The course is developed from a historical perspective, starting from before the Wright brothers and continuing through the Korean War.

AS 2211. Leadership Laboratory
0-2-1. Co-requisite: AS 2210.
Emphasizes development of techniques used to direct and inform. Students are assigned leadership and management positions in the AS 1111 programs.

AS 2220. Evolution of U.S. Air and Space Power II
1-0-1. Co-requisite: AS 2221.
Continues AS 2210 with the history of air power since the Korean War, with emphasis on the U.S. Air Force. Includes the role of air forces in conflicts and the effect of space-age technology on air power. In addition, emphasis on development of communication skills.

AS 2221. Leadership Laboratory
0-2-1. Co-requisite: AS 2220.
Continuation of AS 2211. Emphasis on preparation for field training.

AS 3310. Leadership Studies I
3-0-3. Co-requisite: AS 3311.
Principles, styles, tools, and perspectives of leadership and management with emphasis placed on their application as an Air Force junior officer. Case studies are used to examine Air Force leadership and management situations. Communication skills development continues with the basics of briefing.

AS 3311. Leadership Laboratory
0-2-1. Co-requisite: AS 3310.
Supervisory practice and exercise of leadership functions in controlling and directing activities of the cadet corps. Practical development of leadership potential.

AS 3320. Leadership Studies II
3-0-3. Co-requisite: AS 3321.
Continuation of AS 3310 with emphasis on quality management philosophy, personnel evaluation, and professional ethics. Includes case studies, interactive class exercises, and communication skills exercises.

AS 3321. Leadership Laboratory
0-2-1. Co-requisite: AS 3320.
Continues AS 3311 with emphasis on supervisory and leadership skills, and advantages of an Air Force career.

AS 4410. National Security Affairs
3-0-3. Co-requisite: AS 4411.
An examination of the national security process; the roles of the government and of the military; Air Force doctrine; the roles and missions of the Air Force, Navy, Army, and Marine Corps; and regional studies. Within this structure, continued emphasis is given to refining communication skills.

AS 4411. Leadership Laboratory
0-2-1. Co-requisite: AS 4410.
Exercise of management functions in planning, supervising, and directing cadet corps activities. Emphasis on acquiring proficiency in military leadership skills.

AS 4420. Preparation for Active Duty
3-0-3. Co-requisite: AS 4421.
Continues 4410 with regional studies and military law. Subsequent topics include preparation for active duty; current issues affecting military professionalism; and leadership, management, and core values case studies. Continued emphasis on refining communication skills.

AS 4421. Leadership Laboratory
0-2-1. Co-requisite: AS 4420.
Continues AS 4411. Emphasis on developing top-level management skills. Includes the planning, organizing, and implementation of cadet military training.

School of Economics

Established in 1990
Location: The Habersham Building
781 Marietta Street
Telephone: (404) 894-4919/4917
Fax: (404) 894-1890
Website: www.econ.gatech.edu/
E-mail:
latissia.caldwell@econ.gatech.edu

Chair and Professor–Christine P. Ries; *Associate Director and Associate Professor*–Marilu McCarty; *Professors*–W. Carl Biven (emeritus), Thomas D. Boston, Richard Cebula, Kong Chu (emeritus), William A. Schaffer; *Associate Professors*–Willie J. Belton Jr., Radwan A. Shaban (on leave); *Assistant Professors*–Thomas Dee, Haizheng Li, Mark J. McCabe, Janusz Mrozek, Usha Nair; *Instructor*–John T. McLeod.

General Information

The School of Economics provides high-quality programs of study leading to a Bachelor of Science degree in Economics and to a Certificate in Economics for students in other disciplines. The program focuses on skills and knowledge critical for a life of learning and leading to careers in management, the public sector, and the professions. A degree in economics is especially appropriate for students intending to pursue advanced degrees in the social sciences and in professional schools of management, law, and public administration.

Modern economics is analytically rigorous, requiring a background in mathematics and statistics. At the same time, it is critically linked with the other social sciences and humanities, as well as to the more practical management and policy studies. The undergraduate curriculum provides a strong and broadening overview of economic thought and policy and is intended to prepare students for productive careers, for useful roles in society, and for satisfying personal lives in a technologically complex, culturally diverse world.

The School of Economics also offers graduate courses leading to a Master of Science degree and in support of Ph.D. programs in management, public policy, international affairs, and city planning.

Certificate in Economics

The School of Economics offers a Certificate in Economics for students in all disciplines at Georgia Tech. The certificate program provides a general acquaintance with economic thought and is especially appropriate for students considering graduate work in law or business administration. The certificate program should also be attractive to students who want to apply the tools of economics toward a fuller understanding of the forces that shape the modern world.

The certificate requires a minimum of 12 semester hours of economics courses in which a grade of *C* or better is earned. At least 9 hours of credit must be at the 3000 level or above. Courses required in the student's major degree program may not be used toward the certificate.

Minor in Economics

The School of Economics offers a Minor in Economics for students in all disciplines at Georgia Tech. The minor program provides a general acquaintance with economic thought and is especially valuable for students considering graduate work in law or management. It should also be attractive to students who wish to broaden their education and to understand the forces that shape the modern world. The minor requires a minimum of 18 semester hours in economics, of which 12 semester hours are upper-level courses (numbered 3000 or above). All courses counting toward the minor must be taken on a letter-grade basis and must be completed with an overall grade point average of at least 2.0. Courses required by name and number in a student's major degree program may not be used toward the minor.

Undergraduate Program

Bachelor of Science

The program of study provides a thorough grounding in science, the humanities, and mathematics, a broad grasp of the tools of economic analysis and decision-making, and an understanding of the institutional milieu in which tomorrow's leaders must operate. In addition, the curriculum provides ample opportunities for career-oriented studies in fields such as accounting, finance, management science, public policy, and international affairs; life-enriching studies in history and literature are also available.

BACHELOR OF SCIENCE IN ECONOMICS (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501 or MATH 1712		4
LAB SCIENCE (CHEM, BIOL, PHYS, EAS)		4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		14

First Year - Spring Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502 or MATH 1711		4
LAB SCIENCE (CHEM, BIOL, PHYS, EAS)		4
CS 1301 COMPUTER SCIENCE I		3
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS		16

Second Year - Fall Semester

Course Number/Name		*Hours*
ECON 2100	ECON. ANALYSIS AND POLICY	3
MGT 2250	MANAGEMENT STATISTICS	3
ENGINEERING, SCIENCE, or MATH ELECTIVE		3
HUMANITIES ELECTIVE		3
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		15

Second Year - Spring Semester

Course Number/Name		*Hours*
ECON 2110	ECON. ANALYSIS & DECISION	3
HUMANITIES ELECTIVE		3
INTA ELECTIVE		3
SOCIAL SCIENCE ELECTIVE		6
TOTAL SEMESTER HOURS		15

Third Year - Fall Semester

Course Number/Name		*Hours*
ECON 3110	ADV. MICRO ANALYSIS	3
ECON 3160	INTRO. TO EMPIRICAL ECON.	3
NON MAJOR CLUSTER		3
ECONOMICS ELECTIVE		3
FREE ELECTIVE		3
TOTAL SEMESTER HOURS		15

Third Year - Spring Semester

Course Number/Name		*Hours*
ECON 3161	ECONOMETRIC ANALYSIS	3
FREE ELECTIVE		3
NON-MAJOR CLUSTER		3
ECON 3120	ADV. MACRO ANALYSIS	3
ECON 3150	ECON. AND FINANCIAL MODELING	3
TOTAL SEMESTER HOURS		15

Fourth Year - Fall Semester

Course Number/Name		*Hours*
ECON 4620	HISTORY OF ECON. THOUGHT	3
ECON 4350	INTERNATIONAL ECON	3
ECON ELECTIVE		3
NON MAJOR CLUSTER		3
FREE ELECTIVE		5
TOTAL SEMESTER HOURS		17

Fourth Year - Spring Semester

Course Number/Name		*Hours*
ECON 4610	SEMINAR ON ECON. POLICY	3
ECON 4910	INDIVIDUAL RESEARCH	3
ECON. ELECTIVE		3
FREE ELECTIVE		6
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HRS)

Electives and Requirements

Mathematics

The mathematics requirement may be satisfied by one of the following sequences: MATH 1711-2; MATH 1501-2. Students will not receive credit for MATH 1712 and either MATH 1501 or MATH 1502.

Science and Engineering Electives

Students must complete a laboratory sequence in biology, chemistry, physics, or earth and atmospheric science, along with 3 hours of electives chosen from engineering, science, or mathematics, for a total of 11 hours.

Social Sciences Electives

All students must complete 12 hours of electives in the social sciences, including 3 semester hours from HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200 to satisfy state requirements regarding course work on the history and constitutions of the U.S. and Georgia. Also required are 9 hours from the following list:

Architecture and City Planning
ARCH 4331, 4335, CP 4010, 4020, 4030
History, Sociology, and History, Technology and Society
All HIST, SOC, & HTS courses except 2927, 2928, 2929, 4925, 4926, 4927, 4928, 4929
International Affairs
INTA 1100, 2030, 2100, 2200, 2220, 2230, 3240, 3801, 3802, 3803, 4801, 4802, 4803
Political Science and Public Policy
All POL & PUBP courses except 3113, 3600, 4530, 4532, 4901, 4902, 4903, 4951, 4952
Economics
All ECON courses except 3160, 3200, 4170, 4910, 4990
Psychology
PSYC 1101, 2010, 2020, 2103, 2210, 2220, 2230, 2240, 2260, 2300, 2400, 3060, 4070, 4770

Health and Performance Sciences Electives
Students must take two hours of physical education in the freshman year and may receive the Institute-allowed maximum credits in physical education as free electives.

Humanities Electives
Students are required to complete six hours of humanities from the following list:

Architecture, Industrial Design, and City Planning
COA 2115, 2116, 2241, 2242; ARCH 2111, 2112; ID 2202; MUSI 3610, 3620; CP 4040
Literature, Communication, and Culture
All ENGL and LCC courses except LCC 2661, 2662, 3400, 3402, 3404, 3406, 3408, 3410, 3412, 3661, 3662, 4100, 4102, 4200, 4400, 4402, 4404, 4406, 4600, 4602, 4904, 4906
Modern Languages
All CHIN courses beginning with CHIN 1002 except CHIN 4901, 4902
All FREN courses beginning with FREN 1002 except FREN 4901, 4902
All GRMN courses beginning with GRMN 1002 except GRMN 4901, 4902
All JAPN courses beginning with JAPN 1002
All LING courses except LING 4901, 4902
All RUSS courses beginning with RUSS 1002 except RUSS 4901, 4902
All SPAN courses beginning with SPAN 1002 except SPAN 4901, 4902
Philosophy, Science, and Technology
All PST courses except PST 4901, 4902, 4903

International Elective
Any course offered by the School of International Affairs satisfies this requirement.

Cluster Electives
Students must complete at least 9 hours of credit in a planned cluster in a discipline other than economics. This requirement is most easily satisfied through a certificate program. Any other concentration must be approved by the faculty of the School of Economics. The student must earn a grade of *C* or better in these courses.

Individual Research Project
Each student is required to take ECON 4901, producing a formal research paper in the senior year.

Free Electives
Students must complete free electives (normally bearing 14 hours' credit), bringing the number of credit hours received up to 122. Only free electives may be taken on a pass/fail basis, subject to Institute limitations.

Graduate Program

Master of Science
The School of Economics offers a Master of Science degree for students studying economics at an advanced level. The degree requires a minimum of 30 hours of study under the following restrictions: 1) a minimum of 24 credit hours in economics; 2) a minimum of 15 hours at the 6000 to 9000 level; and 3) a thesis or internship experience for 6 hours or, alternatively, 2 economics electives.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

ECONOMICS

ECON 2100. Economic Analysis and Policy Problems
3-0-3.
Practice in analysis of decision problems of relevance to students in public policy and personal decision areas. Issues relating to individual decisions to produce, consume, invest, and trade will be explored. Analytical approaches will enable students to use and incorporate basic elements of micro and macro economic analysis and to appreciate issues regarding testing and measurement.
Credit not allowed for both ECON 2100 and either ECON 2105 or 2106.

ECON 2105. Principles of Macroeconomics
3-0-3.
This principles of economics course is intended to introduce students to concepts that will enable them to understand and analyze economic aggregates and evaluate economic policies.

ECON 2106. Principles of Microeconomics
3-0-3.
This principles of economics course is intended to introduce students to concepts that will enable them to understand and analyze structure and performance of the market economy.

ECON 2110. Economic Analysis and Decision Making
3-0-3. Prerequisite(s): ECON 2100.
This course builds depth of understanding and analytical ability for the topics addressed in ECON 2100. Assignments will challenge students to original analysis and application of concepts in both micro and macroeconomics. Emphasizes application of economic concepts and economic analysis, measurement and testing. Use of economic analysis to improve decision making in complex and dynamic situations. Credit not granted for both ECON 2110 and either ECON 2105 or 2106.

ECON 3110. Advanced Microeconomic Analysis
3-0-3. Prerequisite(s): ECON 2110 or (ECON 2105 and ECON 2106).
Review of important mathematical tools and techniques used in advanced microeconomics. Advanced topics include the estimation of demand and cost functions; the role of government in the economy (externalities, property rights, and public goods); public choice theory; factor markets (especially labor and capital markets); models of monopoly; pricing techniques used by firms with market power (monopolies and oligopolies); and game theory.

ECON 3120. Advanced Macroeconomic Analysis
3-0-3. Prerequisite(s):(ECON 2100 and 2110) or ECON 2105 and 2106)
Integrates issues arising from international economic relationships with the macroeconomic dynamics of domestic economies. Income determination in the open economy and the effect of stabilization policies on the international monetary system.

ECON 3150. Economic and Financial Modeling
3-0-3. Prerequisite(s): ECON 2110 or (ECON 2105 and ECON 2106).
The course develops student ability to model the essential elements of the investment decision through use of a valuation model and spreadsheet analysis. Expands upon basic knowledge of present value analysis to recognize risk, growth, capital markets, and market valuation of ongoing operations.

ECON 3160. Introduction to Empirical Economics: Data Visualization, Analysis, and Presentation
3-0-3.
Develops student abilities to formulate economic issues logically; identify and collect data from traditional and internet sources; analyze data using spreadsheet and presentation software; generate sound and defensible conclusions and recommendations; and make effective presentations of analysis and conclusions.

ECON 3161. Econometric Analysis
3-0-3. Prerequisite(s): MGT 2250 and ECON 2110 or (ECON 2105 and ECON 2106).
Econometric techniques and applications in economic and business analysis. Practical issues involving modeling, estimation, hypothesis testing, and emphasizing computer implementation through econometric software.

ECON 4060. Money and Capital Markets
3-0-3. Prerequisite(s): ECON 2110 or (ECON 2105 and ECON 2106).
An examination of the role of money in the exchange process, the Federal Reserve's monetary policy strategy, and the impact of monetary policy on financial markets and aggregate economic activity.

ECON 4160. Economic Forecasting
3-0-3. Prerequisite(s): ECON 3161.
An introduction to widely used economic and business forecasting methods, emphasizing quantitative approaches and computer implementation through time-series econometric software.

ECON 4170. Mathematics for Economic Modeling
3-0-3. Prerequisite(s): ECON 3150.
The application of mathematical tools to economic analysis. Topics include static analysis, comparative-static analysis, optimization, and dynamic analysis.

ECON 4301. Economics of Information, Transactions, Costs, and Contracts
3-0-3. Prerequisite(s): ECON 2110 or (ECON 2105 and ECON 2106).
Builds from analysis of the individual in a trading or transaction situation to study organizations as groups of affiliated individuals. Assesses the situations when organizations are preferable to markets as forms of organizing economic and social activity. Institutional economics and transaction cost economics are studied. Analysis of corporate restructuring and privatization.

ECON 4311. Strategic Economics for Global Enterprise
3-0-3. Prerequisite(s): ECON 2110 or (ECON 2105 and ECON 2106).
This introductory course on the multinational enterprise (MNE) will examine from an economic and interdisciplinary perspective the challenges facing MNEs in a fast changing international business environment. The emphasis will be on

the use of economic tools to analyze these issues and understand their managerial implications.

ECON 4321. Economics of Technology, Innovation, and Entrepreneurship
3-0-3. Prerequisite(s): (ECON 2110 and ECON 3110) or (ECON 2105 and ECON 2106 and ECON 3110).
Analysis of level and type of entrepreneurial activity. Study of business and economic history, legal and institutional arrangements.

ECON 4340. Industrial Organization
3-0-3. Prerequisite(s): ECON 2110 or (ECON 2105 and ECON 2106).
Study of the industrial structure of the global economy recognizing competitive and monopolistic sectors. Also recognizes global products and commodities versus customized and local production.

ECON 4350. International Economics
3-0-3. Prerequisite(s): ECON 2110 or (ECON 2105 and ECON 2106).
An introductory course in international economics covering important topics in trade theory, trade policy, and international finance. The emphasis will be on using economic tools to analyze a variety of current events in the world economy.

ECON 4411. Economic Development
3-0-3. Prerequisite(s): ECON 2110 or (ECON 2105 and ECON 2106).
Concepts and studies of developing economies. Selected topics include development experience and theories, growth, agriculture, urbanization, industrialization, and links between trade policy and development.

ECON 4421. Urban and Regional Economics
3-0-3. Prerequisite(s): ECON 2110 or (ECON 2105 and ECON 2106).
Economics of regions, cities, and space. Theories of growth and location, effects of urbanization, agglomeration, and congestion. Public policy relating to urban and regional problems.

ECON 4430. Economics of Transportation and Communication Systems
3-0-3. Prerequisite(s): ECON 2110 and (ECON 2105 and ECON 2106).
Economic analysis for the design, operation, and management of transportation and communication systems. Study of systems analysis and modeling. Application to industry and study of industrial change and dynamics. Special attention to corporate restructuring and industrial consolidation and merger.

ECON 4440. Economics of Natural Resources and the Environment
3-0-3. Prerequisite(s): ECON 2110 and (ECON 2105 and ECON 2106).
This course covers three aspects of environmental economics. First, it considers policy interventions appropriate to problems involving environmental externalities. Second, it explains methods used to estimate economic values for environmental goods. Finally, it explains the economics of depletable and renewable resources.

ECON 4450. Topics in African-American Entrepreneurship
3-0-3.
History and dynamics of African-American business. Impact of racial segregation on business formation. Case studies and empirical exercises.

ECON 4460. Public Economics
3-0-3. Prerequisite(s): ECON 2110 or (ECON 2105 and ECON 2106).
This course focuses on public goods, how public decisions regarding public goods are made, the "free-rider" problem, voting and taxation principles, welfare, the Tiebout hypothesis, budgeting and fiscal policies.

ECON 4510. Economics of Health and Health Care
3-0-3. Prerequisite(s): ECON 2110 or (ECON 2105 and ECON 2106).
This course surveys the theoretical and empirical evidence regarding current issues in health and health care. Individual-level models of health behaviors and the demand for health and medical insurance are presented. The economic behaviors of physicians, hospitals, and insurance companies are also characterized. The possible role of government in encouraging the equitable and efficient performance of health markets is discussed with a particular emphasis on current debates involving individual health decisions, health care reform, and the diffusion of new medical technologies.

ECON 4610. Seminar in Economic Policy
3-0-3. Prerequisite(s): ECON 2110 or (ECON 2105 and ECON 2106).
The objective of the course is to enable students to interpret current economic problems and policies using the economic models learned in their theory courses. Students study the current "Economic Report of the President" and apply analytical tools to the data included in the text. Each student selects a current issue for detailed examination and report.

ECON 4620. History of Economic Thought
3-0-3. Prerequisite(s): ECON 2110 or (ECON 2105 and ECON 2106).
This course is concerned with the economists who interpreted and influenced the development of capitalism and socialism over the last two centuries.

ECON 4801. Special Topics in Economics
3-0-3. Prerequisite(s): ECON 2110 or (ECON 2105 and ECON 2106).
Topics determined by instructor and school chair.

ECON 4901. Special Problems
1-21 hours.
Designed to permit independent study with a faculty member.

ECON 4910. Individual Research in Economics
3-0-3. Prerequisite(s): ECON 2110 or (ECON 2105 and ECON 2106).
Course related to independent student research. Topics determined by instructor and student.

ECON 4990. Internship in Professional Economics
Credit hours to be arranged. Prerequisite(s): ECON 2110 or (ECON 2105 and ECON 2106).
Course projects related to professional internships. Topics and requirements to be arranged by student, instructor, and sponsor.

ECON 6100. Economic Analysis for Managers
3-0-3.
A survey of microeconomic and macroeconomic concepts essential to the academic preparation of prospective managers. Economic theory used as a framework for contemporary managerial decision making.

ECON 6105. Macroeconomics
3-0-3.
Macroeconomic theory, including determination of national income, employment, the general price level, and potential for economic growth. Sources of macroeconomic instability and stabilization policies.

ECON 6106. Microeconomic Analysis
3-0-3.
Microeconomics, resource allocation decisions of households, businesses, and government agencies. Enables the student to understand and apply economic principles to consumer, business, and government decisions.

ECON 6110. Economics of Corporate Strategy
3-0-3. Prerequisite(s): ECON 3110 or ECON 6100.
Applies microeconomic and macroeconomic theory to the development of modern corporate strategy, including organizational boundaries, market structure and competition, industry analysis, and competitive advantage.

ECON 6130. Quantitative Methods in Economics
3-0-3. Prerequisite(s): (ECON 6105 and ECON 6106) or ECON 6100.
Survey of fundamental quantitative tools used in economic analysis, including statistics, matrix algebra, and optimization techniques.

ECON 6150. Cost Benefit Analysis
3-0-3. Prerequisite(s): ECON 3110 or ECON 6106.
The application of economic, financial, and quantitative reasoning and tools to issues of resource allocation and policy, primarily in the public sector.

ECON 6160. Econometric Analysis
3-0-3.
Introduction to econometric modeling with an emphasis on applications and computer implementation with econometric software.

ECON 6161. Econometric Modeling and Forecasting
3-0-3. Prerequisite(s): ECON 6160.
Advanced econometric modeling including an emphasis on applications with time-series data and computer implementation with econometric software.

ECON 6200. Money and Capital Markets
3-0-3. Prerequisite(s): ECON 3120 or ECON 6105.
The role of money in the exchange process, Federal Reserve strategy, and the impact of monetary policy on financial markets and aggregate economic activity.

ECON 6310. Public Economics
3-0-3. Prerequisite(s): ECON 6100 or (ECON 6105 and ECON 6106).
An examination of public goods, public decision making, voting, free riders, taxation principles, welfare, the Tiebout Hypothesis, budgeting, and fiscal policy.

ECON 6330. Urban and Regional Economics
3-0-3. Prerequisite(s): ECON 6100 or (ECON 6105 and ECON 6106).
Economics of regions, cities, and space. Theories of growth and location, effects of urbanization, agglomeration, and congestion. Public policy relating to urban and regional problems.

ECON 6360. Development Economics
3-0-3. Prerequisite(s): ECON 6100 or ECON 6106.
Concepts of development including empirical studies and country experiences. Topics include growth, poverty and inequity, agricultural development, industrialization, urbanization, trade, and globalization.

ECON 6380. Economics of Natural Resources and the Environment
3-0-3. Prerequisite(s): ECON 6100 or (ECON 6105 and ECON 6106).
Environmental economics, including policy interventions involving environmental externalities. Methods used to estimate economic values for environmental goods. The economics of depletable and renewable resources.

ECON 6431. Strategic Economics for Global Enterprise
3-0-3. Prerequisite(s): ECON 6100 or (ECON 6105 and ECON 6106).
Challenges facing multinational enterprises in a fast-changing international business environment. Use of economic tools to analyze these issues and understand their managerial implications.

ECON 6440. The Economics of Technology, Innovation, and Entrepreneurship
3-0-3. Prerequisite(s): ECON 6100 or ECON 6106.
Basic economic models are used to explain the significance of entrepreneurial activity for technological progress and economic growth.

ECON 6450. Topics in African-American Entrepreneurship
3-0-3.
Trends in black entrepreneurship and business development, including the impact of government policies, and business development and inner-city revitalization.

ECON 6460. The Industrial Organization of the Economy
3-0-3. Prerequisite(s): ECON 6100 or ECON 6106.
Industrial structure of the global economy recognizing competitive and monopolistic sectors. Global products and commodities versus customized and local production.

ECON 6510. Economics of Health and Health Care
3-0-3. Prerequisite(s): ECON 6106 and ECON 6160.
A critical survey of the current theoretical and empirical issues involving the economics of health and health care.

ECON 6610. Seminar in Economic Policy
3-0-3. Prerequisite(s): ECON 6100 or (ECON 6105 and ECON 6106).
Interprets current economic problems and policies using fundamental economic principles.

ECON 6620. History of Economic Thought
3-0-3. Prerequisite(s): ECON 6100 or (ECON 6105 and ECON 6106).
Economists who interpreted and influenced the development of captialism and socialism over the last two centuries.

ECON 6650. International Economics and Policy Analysis
3-0-3. Prerequisite(s): ECON 6100 or (ECON 6105 and ECON 6106).
Theoretical and empirical analysis of international economics: international trade models, strategic trade and commercial policies, foreign exchange, multinational operations and issues in international economy.

ECON 7000. Master's Thesis
Credit hours to be arranged.

ECON 8801,-2,-3. Special Topics
Credit and class hours equal last digit of course number.

ECON 8910,-90. Special Problems
Credit hours to be arranged.

ECON 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding teaching assistantships.

ECON 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding research assistantships.

School of History, Technology, and Society

Established in 1990
Location: D.M. Smith Building
Telephone: (404) 894-2182
Fax: (404) 894-0535
Web address: www.gatech.edu/hts

Chair and Professor–Gregory H. Nobles; *Melvin Kranzberg Professor of the History of Technology*–Philip Scranton; *Professors*–Ronald H. Bayor, Lawrence Foster, Mary Frank Fox, August W. Giebelhaus, Kenneth J. Knoespel (Joint Appointment, Associate Dean, Ivan Allen College), Robert C. McMath Jr. (Vice Provost for Undergraduate Studies and Academic Affairs), Carole E. Moore (Director of Academic Services/Athletic Association), Jonathan Schneer; *Associate Professors*–Douglas Flamming, Daniel L. Kleinman, Hanchao Lu, Andrea Tone, John L. Tone, Stephen W. Usselman, Steven P. Vallas; *Assistant Professors*–Eleanor Alexander, Michael Allen, Alice Bullard, Chiquita Collins.

General Information

The School of History, Technology, and Society (HTS), dedicated to the ideal of a well rounded education at a technological university, provides instruction in the social sciences to every student at the Georgia Institute of Technology. The School offers courses in history and sociology leading to the degrees of Bachelor of Science in History, Technology, and Society; Master in History of Technology; and Doctor of Philosophy in History of Technology. HTS also offers a variety of minor and certificate programs for students in other undergraduate majors.

Undergraduate Program

Bachelor of Science

The HTS degree is comparable to traditional degrees in history and sociology, but the program has several attributes that make it unique. The degree requires broad-based training in humanities, mathematics, science, and social sciences, giving HTS graduates the advantage of a truly broad, humanistic education. The program's focus on the social origins and impact of industry, science, and technology is also distinctive, providing students with the critical tools needed to understand the complex issues related to the development of the modern world.

Students who wish to pursue careers or graduate study in business, education, government, journalism, law, publishing, and many other fields will benefit from this degree program. Through an arrangement with Georgia State University, HTS majors interested in teaching careers may register for education credits to gain public school certification.

Minor and Certificate Programs

For students in other majors interested in broadening their educational experience at Georgia Tech, HTS offers minors in history and in sociology, and jointly administers a minor in Women, Science, and Technology (WST).

Alone or in conjunction with other units of the Ivan Allen College, HTS offers certificates in five fields:

African-American Studies
Asian Affairs
European Affairs
History
Sociology

The School of History, Technology, and Society also offers courses that are included in the Pre-Law certificate awarded by the School of Public Policy.

Minors are awarded upon completion of six approved courses. Certificates require four approved courses. All courses must be taken on a letter-grade basis with a grade of *C* or better. Certificates and minors will be granted only to students who have satisfied requirements for an undergraduate major degree. For more information on the minors and certificates, contact the director of Undergraduate Studies in HTS, John L. Tone, at (404) 894-8631.

BACHELOR OF SCIENCE IN HISTORY, TECHNOLOGY, AND SOCIETY (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501 or MATH 1712		4
LAB SCIENCE (CHEM, BIOL, PHYS, EAS)		4
HIST 2111 or 2112 U.S. HISTORY		3
HPS 1040/1061 WELLNESS		2
TOTAL SEMESTER HOURS		16

First Year - Spring Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502 or MATH 1711		4
LAB SCIENCE (CHEM, BIOL, PHYS, EAS)		4
SOC 1101	INTRO TO SOCIOLOGY	3
CS 1301	COMPUTER SCIENCE I	3
TOTAL SEMESTER HOURS		17

Second Year - Fall Semester

Course Number/Name		*Hours*
HTS 1031	EUROPE SINCE THE RENAISSANCE	3
HTS ELECTIVE		3
ML HUMANITIES ELECTIVE		3
FREE ELECTIVE		6
TOTAL SEMESTER HOURS		15

Second Year - Spring Semester

Course Number/Name	*Hours*
ECON 2105, 2106, or 2100	3
HTS ELECTIVE (TECHNOLOGY & SOCIETY)	3
ML HUMANITIES ELECTIVE	3
FREE ELECTIVE	6
TOTAL SEMESTER HOURS	15

Third Year - Fall Semester

Course Number/Name	*Hours*
HTS 3101 LOGIC/HIST. & SOCIAL RESEARCH	3
HTS ELECTIVES	6
FREE ELECTIVE	6
TOTAL SEMESTER HOURS	15

Third Year - Spring Semester

Course Number/Name		*Hours*
HTS 3102	SOCIAL THEORY AND STRUCTURE	3
HTS ELECTIVES		6
FREE ELECTIVE		3
HTS ELECTIVE (TECHNOLOGY & SOCIETY)		3
TOTAL SEMESTER HOURS		15

Fourth Year - Fall Semester

Course Number/Name	*Hours*
HTS SEMINAR	4
HTS ELECTIVE	6
FREE ELECTIVE	6
TOTAL SEMESTER HOURS	16

Fourth Year - Spring Semester

Course Number/Name	*Hours*
HTS SEMINAR	4
HTS ELECTIVE	3
FREE ELECTIVE	6
TOTAL SEMESTER HOURS	13

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HRS)

Requirements and Electives

History and Government Requirement

The state of Georgia requires all students to take a course on the government and history of the United States and Georgia. Any one of the following courses will fulfill this requirement: HIST 2111, HIST 2112, INTA 1200, POL 1101, or PUBP 3000.

Writing and Communication Intensive Courses

A number of majors require students to complete writing intensive and communication intensive courses. Several HTS classes may be counted toward this requirement, including many 3000-level courses and all 4000-level seminars. Consult course offerings each semester to determine which courses may be counted toward this requirement.

Requirements for the Bachelor of Science in History, Technology, and Society

Core Curriculum
Computing: CS 1301
English: ENGL 1101 and 1102

Humanities and Fine Arts

Students must complete two approved humanities courses from the following departments: Architecture, LCC, Industrial Design, Modern Languanges, Music, and Philosophy. See the list of approved courses on pages 33-34 of this catalog.

Mathematics

Students must complete one of the following mathematics sequences: Math 1711 and 1712, or Math 1501 and 1502.

Science

Students must take two of the following eight courses. BIOL 1510 and 1520, CHEM 1312 and 1313, EAS 1600 and 1601, or PHYS 2211 and 2212.

Social Science

Students are required to take four approved social sciences courses from any of the following departments: Architecture, Economics, HTS, International Affairs, Psychology, and Public Policy. See pages 33-34 of this catalog for a list of approved social science courses. To satisfy state requirements regarding course work on the history and constitutions of the U.S. and Georgia, students must complete one of the following courses: HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200.

Courses Related to Major

- **Foreign Language**
  Students must complete a two-course sequence in a foreign language.
- **Economics**
  Students must take one of the following: ECON 2100, 2105, or 2106
- **Sociology**
  SOC 1101
- **European History**
  HTS 1031
- **United States History**
  HIST 2111 or 2112

Courses in Major

- **Technology and Society**
  Students must complete two courses from an approved list that includes: HTS 2081, 2082, 2084, 3001, 3007, 3020, 3021, 3082, 3083, 3084, and 3085.
- **Historiography and Methods**
  HTS 3101
- **Social Theory**
  HTS 3102
- **Seminar**
  Students must complete two HTS 4000-level seminars, preferably in their junior and senior years.
- **Additional HTS Electives**
  Students must take 21 credit hours of additional HTS courses.
- **Free Electives**
  Students must take 18-33 credit hours of courses in any discipline to reach a total of 120 hours for graduation.
- **Health and Performance Sciences**
  HPS 1040 or 1061. Students must complete a two-hour sequence in health and performance sciences, but these two hours are not counted toward the 120-hour minimum for graduation.

Graduate Program

The School offers a program of graduate study in the history of technology at both the master's and doctoral level. The two-year master's program consists of foundation courses in history, social theory, and research methods, as well as more specialized reading and research seminars. The program emphasizes the understanding of technology within a broad social and historical context. Students develop a strong general background in American and European history and acquire skills in historical research, social analysis, and writing.

The basic curriculum of 36 hours (required of both M.S. and Ph.D. candidates) consists of 12 hours of required fundamental courses, including six hours' credit for a major research paper, 15 hours of core electives within HTS, an advanced interdisciplinary seminar, and six hours of free electives. Students pursuing the Ph.D. must complete an additional 18 hours of course work in preparation for the comprehensive examinations, which are normally taken at the end of the third academic year. The examinations will cover material from four fields of study, including one in the history of technology and one in an area of sociology.

In addition to satisfactory performance in the comprehensive examinations, students must also pass a foreign language examination (normally in French or German) before being admitted to candidacy for the Ph.D. Having met these requirements, the candidate will submit a dissertation proposal, which must meet the approval of his or her dissertation committee. The candidate will then proceed to the final requirement for the degree: the completion of the Ph.D. dissertation and its successful defense by oral examination.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

HISTORY

HIST 2111. The United States to 1877
3-0-3.
Colonial settlement, the American Revolution and the Constitution, antebellum expansion, slavery and plantation economy, sectional conflict and Civil War, Reconstruction.

HIST 2112. The United States since 1877
3-0-3.
The social, political, and economic history of the United States since Reconstruction. Topics include American industrialization, two world wars, the New Deal, and the Civil Rights movement.

SOCIOLOGY

SOC 1101. Introduction to Sociology
3-0-3.
A study of basic social relations, including social structure and functions, analysis of social processes, the foundations of personality, and analysis of social organization.

HISTORY, TECHNOLOGY, AND SOCIETY

HTS 1031. Europe Since the Renaissance
3-0-3.
Social, political, economic, and cultural history of Europe since the Renaissance. Topics include Renaissance; Reformation; political, scientific, and industrial revolutions; nationalism, fascism, and communism; decolonization.

HTS 1081. Engineering in History
3-0-3.
Uses historical case studies to examine the relationship between engineers and the larger society in which they function. Often taught jointly with engineering faculty.

HTS 2001. Early American History
3-0-3.
North America to 1763, including native cultures, contacts with European colonizers, settlement strategies and patterns, and foundation of American political and economic institutions.

HTS 2002. The American Revolution and Constitution
3-0-3.
The American Revolution as political debate, war, and social upheaval, with attention to the framing and ratification of the Constitution.

HTS 2006. History of the Old South to 1865
3-0-3.
A study of social, political, and economic developments in the South from the Colonial period through the Civil War.

HTS 2007. History of the New South since 1865
3-0-3.
An examination of social, political, and economic developments from the Reconstruction period to the present.

HTS 2009. The American Civil War
3-0-3.
Social, economic, political, and military aspects of the Civil War, including causes of the war, military campaigns, and long-term consequences.

HTS 2011. The Gilded Age and the Progressive Era
3-0-3.
Populism, the currency question, immigration, the rise of big business, war, and reform in one of the most turbulent periods of American history.

HTS 2013. Modern America: World War II and After
3-0-3.
Dawning of the atomic age, anticommunism, the Civil Rights Movement, New Frontier and Great Society, Vietnam and the tumultuous 1960s, and end of the Cold War.

HTS 2016. Social Issues and Public Policy
3-0-3.
Draws on sociological theory and research to understand the major economic, social, and cultural issues facing American society today.

HTS 2031. Ancient Greece: Gods, Hereos, and Ruins
3-0-3.
Minoan and Mycenaean civilizations, Homer's Greece, Classical Athens and Sparta, myths and legends in historical context. Course ends with Alexander the Great and the rise of Rome.

HTS 2032. Ancient Rome: From Greatness to Ruins
3-0-3.
Growth of the Republic, antics and follies of the emperors, accomplishments of Rome, and causes of decline. Early Christianity and its impact on Europe included.

HTS 2033. Medieval Europe: 350 to 1400
3-0-3.
The rise of barbarian kingdoms from Rome's ashes, the explosion of Islam, the monastic movement, Charlemagne's empire, the blossoming of medieval culture, and developing European monarchies.

HTS 2036. Revolutionary Europe: 1789-1914
3-0-3.
Industrialization and political revolution, the development of political ideologies and labor activism, modern nation-state building, and imperialism from the French Revolution to World War I.

HTS 2037. Twentieth Century Europe: 1914 to Present
3-0-3.
Global war and the Bolshevik Revolution, rise and fall of Mussolini and Hitler, Stalinism, the Holocaust, Cold War, decolonization, and the movement toward European integration.

HTS 2061. Traditional Asia and Its Legacy
3-0-3.
Civilizations of East Asia up to 1850, emphasizing traditional cultures in China and Japan, including religion, science, formation of empires, social life, and commerce.

HTS 2062. Asia in the Modern World
3-0-3.
Civilizations of India, China, and Japan since 1600, emphasizing Western impact and adaptation of these countries' political, economic, and social systems.

HTS 2081. The Scientific Revolution
3-0-3.
A critical approach to the Scientific Revolution, introducing students to primary documents and images from the period and emphasizing interpretive strategies and methods.

HTS 2082. Technology and Science in the Industrial Age
3-0-3.
Surveys major developments in technology and science since 1600 and places them in the broader social context of their times.

HTS 2084. Technology and Society
3-0-3.
Analyzes social conditions that promote or retard technological activity, emphasizing role of business, the state, and scientific and engineering professions, and the emergence of consumerism.

HTS 2875,-6,-7. Special Topics in History, Technology, and Society
3-0-3, each.
Allows a group of students and a professor to study topics not covered in other courses in the department.

HTS 2927,-8,-9. Special Problems
Credit hours to be arranged.

HTS 3001. American Economic History
3-0-3.
U.S. economic history since 1607, including regional specialization, agriculture, industrialization, technology, government and economy, money and banking, labor, international trade, and contemporary economic problems.

HTS 3002. History of American Business
3-0-3.
Evolution of business institutions from Colonial period to present, including entrepreneurship, business-government relations, institutional innovation, and 20th-century managerial capitalism.

HTS 3003. Sociology of Economic Institutions
3-0-3.
Examines links between economic structures-markets, regulatory bodies, and labor relations systems-and the wider structural and cultural context.

HTS 3005. American Environmental History
3-0-3.
Transformation of the North American environment since 1500, including different notions of nature, romantic responses to wilderness during industrialization, rise of conservation movements, and environmental policy.

HTS 3006. United States Labor History
3-0-3.
The changing nature of work and labor relations, with focus on unionization, government regulation, and equity issues in the workplace.

HTS 3007. Sociology of Work, Industry, and Occupations
3-0-3.
Analyzes paid employment as a decisive social attachment, emphasizing work organizations, technological change and authority relations, and social inequality among diverse groups of employees.

HTS 3011. The City in American History
3-0-3.
Examines the historical background of the American city since colonial times, including city planning, urban technology and services, neighborhoods, and race relations.

HTS 3012. Urban Sociology
3-0-3.
Sociological perspectives on the city, urbanization, and problems of community; evolution of cities and problems of urban life in the U.S. and Third World.

HTS 3015. History of the Vietnam War
3-0-3.
Diplomatic, military, and social aspects of America's war in Vietnam, including antiwar protests, the defense industry boom, and the war's enduring impact on American life.

HTS 3016. Women and Gender in the United States
3-0-3.
Course examines themes and theories of women's and gender history since the Colonial period, including work, family, race, sexuality, and politics.

HTS 3017. Sociology of Gender
3-0-3.
Gender as a dimension of social life that shapes and is shaped by the economy, schooling, family, politics, medicine and health, race, and social class.

HTS 3020. Gender and Technology
3-0-3.
Course examines the ways in which the design, development, and application of technologies, as well as cultural responses to them, have been gendered historically.

HTS 3021. Women in Science and Engineering
3-0-3.
Women in science and engineering and gender differences in participation, location, and status. Examines education, access, and apprenticeship, culture of science and engineering.

HTS 3024. African-American History to 1865
3-0-3.
The experience of African and African-American people in North America from the beginnings of slavery until the era of emancipation in the Civil War.

HTS 3025. African-American History since 1865
3-0-3.
The African-American experience since 1865, including Reconstruction, segregation, the African-American family, the Harlem Renaissance, the Civil Rights Movement, and Black Power.

HTS 3026. Sociology of Race and Ethnicity
3-0-3.
Nature and significance of dominant/minority relations, including legacies of colonialism and slavery, roots of residential segregation, and effects of race on American politics.

HTS 3031. European Labor History
3-0-3.
The labor movement from 1700s to the present, including an examination of Marx and socialism, unionization, and work conditions, especially in Britain, Germany, and France.

HTS 3032. Modern European Intellectual History
3-0-3.
Introduction to intellectual problems and trends in modern Europe, including loss of faith in progress, evil and ethics, post-colonialism, feminism, linguistics, and psycho-analytic thought.

HTS 3033. Medieval England
3-0-3.
Political, economic, and cultural development of England during the Middle Ages (c. 350-1400). Myths and legends of Stonehenge, the Druids, and King Arthur's Camelot explored.

HTS 3035. Britain from 1815-1914
3-0-3.
Developments in 19th-century Britain, including the industrial revolution, the growth of political democracy, imperialism, and movements for Irish Home rule and democratic socialism.

HTS 3036. Britain Since 1914
3-0-3.
Britain's experience of two world wars, the growth of Labour and decline of the Liberals, the Welfare State, Thatcherism, and Tony Blair's "New Labour."

HTS 3038. The French Revolution
3-0-3.
Economic, intellectual, and cultural causes of the French Revolution; Jacobinism and the Terror; careers of Robespierre and Danton; and rise and fall of Napoleon's empire.

HTS 3039. Modern France
3-0-3.
France from 1815 to 1968, emphasizing the continuing project of creating France as a powerful nation within the context of global culture and politics.

HTS 3041. Modern Spain
3-0-3.
Resistance to Napoleon, deformed industrialization, Anarchist and facist experiments form the background for Spain's transition from dictatorship to democracy after Franco's death.

HTS 3043. Modern Germany
3-0-3.
Consolidation of Germany since Napoleonic wars, Germany's contributions both hideous and glorious to Europe and the West, and recent unification of East and West Germany.

HTS 3045. The Holocaust
3-0-3.
Genocide in the 20th century, emphasizing the extermination of European Jews. Course investigates roots of racism, eugenics, and ideologies of genocide in comparative perspective.

HTS 3061. Modern China
3-0-3.
The decline of Confucian order, the impact of the West, changes and continuities of Chinese culture, the Communist revolution, nationalism, and economic reforms since 1978.

HTS 3062. Modern Japan
3-0-3.
Japan's transformation in one century from a feudal state into an economic superpower and the impact of these changes on the Japanese people.

HTS 3063. Outposts of Empire: Comparative History of British Colonization
3-0-3.
Analysis of four British settlement colonies-Australia, New Zealand, Canada, and South Africa-emphasizing settlement, race relations, and national identity.

HTS 3064. Sociology of Development
3-0-3.
Course examines competing perspectives on international development and surveys some of the crucial issues, including political instability, facing the Third World today.

HTS 3066. Sociology of Politics and Society
3-0-3.
Political sociology studies the way power is distributed in society. This course takes a comparative and historical approach, focusing on the development of the nation-state.

HTS 3067. Revolutionary Movements in the Modern World
3-0-3.
Comparative analysis of the origin, development, and impact of major 20th-century revolutionary movements.

HTS 3082. Sociology of Science
3-0-3.
The growth of science, its social structure-deviance and norms, the social context of scientific knowledge and practice, and science policy.

HTS 3083. Technology and the Shaping of American Society
3-0-3.
The complex interplay between technical innovation and cultural change in the United States since 1850, with emphasis on the emergence of the modern consumer-oriented society.

HTS 3084. Culture and Technology
3-0-3.
Modernism and post-modernism: this course investigates culturally creative responses to modern manufacturing, transportation (trains, cars, airplanes), evolving gender ideals, and new communications.

HTS 3085. Law, Technology, and Politics
3-0-3.
Examines the ways in which courts, legislatures, and regulatory agencies have responded to challenges posed by new technology and shaped the course of technical change.

HTS 3086. Sociology of Medicine and Health
3-0-3.
Relationship between health and society, including health care problems in the U.S. and culture's role in defining health and sickness and in determining appropriate therapies.

HTS 3101. Logic of Historical and Social Research
3-0-3.
Interdisciplinary survey based on critical readings of the methods historians and social scientists use to generate knowledge about social life. Students engage in "hands-on" research.

HTS 3102. Social Theory and Social Structure
3-0-3.
Introduction to social theory, providing students with skills for reading theory and examining works of major social theorists including Marx, Weber, Durkheim, Gilman, and Bourdieu.

HTS 4001,-2,-3,-4,-5. Seminar in United States History
4-0-4, each.
Advanced undergraduate topics in U.S. history. Designed for HTS majors, but open to other students with junior or senior standing.

HTS 4011,-2,-3,-4,-5. Seminar in Sociology
4-0-4, each.
Advanced undergraduate topics in sociology. Designed for HTS majors, but open to other students with junior or senior standing.

HTS 4031,-2,-3,-4,-5. Seminar in European History
4-0-4, each.
Advanced undergraduate topics in European history. Designed for HTS majors, but open to other students with junior or senior standing.

HTS 4061,-2,-3,-4,-5. Seminar in Asian History
4-0-4, each.
Advanced undergraduate topics in Asian history. Designed for HTS majors, but open to other students with junior or senior standing.

HTS 4081,-2,-3,-4,-5. Seminar in History of Technology
4-0-4, each.
Advanced undergraduate topics in the history of technology. Designed for HTS majors, but open to other students with junior or senior standing.

HTS 4875,-6,-7. Special Topics in History, Technology, and Society
3-0-3, each.
Allows a group of students and a professor to study topics not covered in other courses in the department.

HTS 4925,-6,-7,-8,-9. Special Problems in History, Technology, and Society
Credit hours to be arranged.
Individual studies of topics of current interest in History, Technology, and Society.

HTS 6001. Proseminar in Social Theory
3-0-3.
An introduction to key theoretical traditions in modern social theory, including both classical and contemporary works.

HTS 6002. Proseminar in the History of Technology
3-0-3.
Indentifies major areas of interest in the history of technology and introduces a variety of approaches to the discipline.

HTS 6101. Social and Political History of the United States
3-0-3.
Examines the social experiences of Americans and the political contexts in which they lived.

HTS 6102. Social and Political History of Europe
3-0-3.
Classic works and debates in European social history, including transition from feudalism to capitalism, French Revolution, rural history and industrialization, and origins of nationalism.

HTS 6103. Social and Political History of the Nonwestern World
3-0-3.
Covers basic empirical and relevant theoretical literature in English on the social and political history of Africa, Asia, and/or Latin America.

HTS 6105. Urbanization and Comparative Development
3-0-3.
An intensive introduction to the political, social, economic, and technological forces involved in the processes of urbanization and global development.

HTS 6106. Business Organizations and Political Economy
3-0-3.
Examines the historical evolution and contemporary operations of business institutions within the larger context of political economy; emphasis on business, government, and technology.

HTS 6107. Workers and the Labor Process
3-0-3.
Examines subjects such as the meaning of work, working-class movements, and workers' accommodation and resistance to managerial and technological changes in the workplace organization.

HTS 6108. Race, Ethnicity, and Industrialization
3-0-3.
Examines racial and ethnic dimensions of industrializing societies and industrial settings; links industrial change with shifts in race relations, ethnic identities, and minority behavior.

HTS 6109. Gender, Sexuality, and Society
3-0-3.
Explores constructions of gender roles and sexuality in history and in contemporary society.

HTS 6110. Gender, Science, and Technology
3-0-3.
Examines the ways in which gendered relations shape scientific and technological institutions, careers, artifacts, knowledge, and culture.

HTS 6111. Technology and Modern Culture
3-0-3.
Introduces the complex interplay between technological systems and diffuse systems of consumption, social organization, and culture beyond the act of production.

HTS 6112. Studies in Science and Engineering
3-0-3.
Empirical investigation of scientific and engineering practice in historical and contemporary settings.

HTS 7001. Foundations of Socio-Historical Analysis
3-0-3.
Introduces key concepts and methods used in the historical analysis of social phenomena.

HTS 7002. Research and Writing Seminar
3-0-3.
Introduces methods of socio-historical research and writing; requires preparation of an original research paper based on primary sources.

HTS 8001. Comparative History of Labor, Industry, Technology, and Society
3-0-3.
An intensive, team-taught reading seminar covering major themes and classic works in these fields.

HTS 8002. Social and Cultural Perspectives on Technology and Science
3-0-3.
An intensive, team-taught seminar examining technology and science through techniques and perspectives drawn form social and cultural studies.

HTS 8801,-2,-3,-4,-5,-6. Special Topics
Credit and class hours equal last digit of course number.

HTS 8901,-2,-3,-4,-5,-6. Special Problems
Credit hours to be arranged.

HTS 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding a teaching assistantship.

HTS 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding a research assistantship.

HTS 9000. Doctoral Thesis
Credit hours to be arranged.

The Sam Nunn School of International Affairs

Established in 1990
Location: Habersham Building
781 Marietta Street
Telephone: (404) 894-3195
Fax: (404) 894-1900
Website: www.inta.gatech.edu

Chair and Professor–Linda P. Brady; *Director of Graduate Programs and Professor*–William J. Long; *Director of Undergraduate Programs and Associate Professor*–Brian Woodall; *Professors*–John E. Endicott, John W. Garver, Robert Kennedy, Sam Nunn, Daniel S. Papp, Michael D. Salomone; *Assistant Professors*–Kirk Bowman, Peter Brecke, William Roberts Clark, Molly Cochran, Mark R. Hallerberg, Jesus Felipe, Adam Stulberg, Fei-Ling Wang, Katja Weber; *Jointly Appointed Professors*–John R. McIntyre, Arthur C. Nelson, Edmun B. Richmond, Richard D. Teach; *Jointly Appointed Associate Professor*–Richard P. Barke.

General Information

The Sam Nunn School of International Affairs offers educational programs that provide an enhanced understanding of the factors that shape the world in which we will live and work in the 21st century. The programs of study equip students with the quantitative and qualitative skills needed to engage in strategic planning and analysis in an international context. A unique interdisciplinary curriculum provides students with an understanding of the increasing importance of technology in a borderless world. Many graduates assume professional positions with business, government, and international organizations. Other graduates pursue postgraduate or professional education in a range of disciplines that includes law, business, international affairs, public administration, and economics.

The Sam Nunn School of International Affairs is the only one of its kind at a leading technological institute. The educational programs administered by the Sam Nunn School at Georgia Tech are designed to equip students with the skills, values, and experience to build bridges between the world of science and the world of international relations.

Undergraduate Program

Bachelor of Science

The Bachelor of Science in International Affairs (B.S.I.A.) program includes instruction in international affairs, foreign languages, ethics and philosophy, social and natural sciences, and computer science. Upper-division course work provides training in four substantive areas:

- technology, ethics, and scientific analysis;
- international security and diplomacy;
- comparative politics, cultures, and societies; and
- international political economy.

Graduates of the B.S.I.A. program are prepared for advanced graduate and professional study and are ready for employment in internationally oriented firms, government agencies, and non-profit organizations.

International Affairs majors are strongly encouraged to enhance their education through participation in study abroad programs, internships, and a host of on- and off-campus programs. In addition to the numerous opportunities afforded through Georgia Tech's Study Abroad Office, the Sam Nunn School sponsors rigorous summer study abroad programs in the European Union (Brussels), China (Shanghai), and Argentina (Buenos Aires). Recognizing the importance of professional experience in enhancing a student's education, the Sam Nunn School encourages majors to pursue an internship or participate in the Cooperative Plan in their field of interest. In addition, students are strongly encouraged to get involved in a range of extracurricular activities, including Model United Nations; the European Union Center; AIESEC; the Center for International Strategy, Technology, and Policy; the International Affairs Student Organization; and student conferences. Students are encouraged to take advantage of guest lecturers and to participate in the annual Sam Nunn/NationsBank Policy Forum, the Asian Issues Lecture Series, and the annual report of former U.S. Secretaries of Defense.

BACHELOR OF SCIENCE IN INTERNATIONAL AFFAIRS (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501 or MATH 1712		4
CS 1301	COMPUTER SCIENCE I	3
ML ELECTIVE		3
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS		15

First Year - Spring Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502 OR MATH 1711		4
CS 1302	COMPUTER SCIENCE II	3
ML ELECTIVE		3
INTA 1110	INTRO. TO INTL. RELATIONS	3
TOTAL SEMESTER HOURS		16

Second Year - Fall Semester

Course Number/Name		*Hours*
INTA 2010	EMPIRICAL METHODS	3
INTA 2030	ETHICS IN INTL AFFAIRS	3
ML ELECTIVE		3
LAB SCIENCE (CHEM, BIOL, PHYS, EAS)		4
HTS 1031, 2036, 2037, 2062		3
TOTAL SEMESTER HOURS		16

Second Year - Spring Semester

Course Number/Name		*Hours*
INTA 2100	GREAT POWER RELATIONS	3
INTA 2210	COMP. POLITICAL PHIL.	3
ML ELECTIVE		3
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
LAB SCIENCE (CHEM, BIOL, PHYS, EAS)		4
TOTAL SEMESTER HOURS		16

Third Year - Fall Semester

Course Number/Name		*Hours*
INTA 3110	U.S. FOREIGN POLICY	3
INTA ELECTIVE		3
FREE ELECTIVE		3
ECON 2105 OR ECON 2106		3
CLUSTER ELECTIVE		3
TOTAL SEMESTER HOURS		15

Third Year - Spring Semester

Course Number/Name		*Hours*
INTA 3203	COMPARATIVE POLITICS	3
INTA ELECTIVE		3
INTA 3301	INTL POLITICAL ECON	3
FREE ELECTIVE		3
CLUSTER ELECTIVE		3
TOTAL SEMESTER HOURS		15

Fourth Year - Fall Semester

Course Number/Name		*Hours*
INTA 4010	SCIENCE, TECHNOLOGY & INTA	3
INTA ELECTIVE		6
CLUSTER ELECTIVE		6
TOTAL SEMESTER HOURS		15

Fourth Year - Spring Semester

Course Number/Name		*Hours*
INTA 4400	SENIOR SEMINAR: INTA STAT. & POL.	3
CLUSTER ELECTIVE		3
FREE ELECTIVE		8
TOTAL SEMESTER HOURS		14

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HRS)

Requirements and Electives

The International Affairs Core

Student majors acquire an understanding of the core issues in international affairs by completing the following required courses: INTA 1110, 2010, 2030, 2100, 2210, 3110, 3203, 3301, and 4010. Students are encouraged to complete INTA 2010 early on in order to make the most of their upper-division studies. In addition, student majors are required to round out their studies with INTA 4400, a capstone senior seminar.

Health and Performance Science

All Georgia Tech students must complete HPS 1040/1061, a two-hour health and "wellness" course.

Humanities and Fine Arts

The ability to communicate effectively is essential to success in almost any meaningful endeavor. To this end, students are required to complete six hours of humanities/fine arts course work, including ENGL 1101 and 1102. In addition to 12 hours of modern foreign language study (see the following section, "Courses Related to the Major"), student majors are encouraged to satisfy the Humanities/Fine Arts requirement with additional foreign language course work.

Social Science Electives
In order to satisfy the U.S./Georgia history and Constitution requirements, students must complete one of the following courses: INTA 1200, HIST 2111, HIST 2112, POL 1101, or PUBP 3000. International Affairs majors are encouraged to take INTA 1200, which examines American government in relation to political and economic systems in countries around the world. In addition, students are required to complete nine hours of social science course work from a list of designated courses.

Mathematics and Sciences
An understanding of scientific methodology and quantitative analytic skills is essential for practitioners and policymakers in today's international arena. The mathematics requirement may be satisfied by one of the following sequences: MATH 1501-2 or MATH 1711-2. In addition, students are required to complete six hours in one of the following sequential laboratory science courses: BIOL I-II, CHEM I-II, EAS I-II, or PHYS I-II.

Computer and Information Literacy
The information revolution is transforming international affairs. More than ever before, the solution of real-world problems demands an understanding of and the ability to use computers and information technology. In order to gain these essential skills, students are required to complete CS 1301 and CS 1302.

Courses Related to the Major
The BSIA curriculum is multidisciplinary, and student majors are required to complete a total of 18 hours of courses in fields related to the major. This requirement is satisfied by completing the following courses: 12 hours of foreign language study; ECON 2105 or 2106; and one of the following courses that survey European or Asian history: HST 1031, 2036, 2037, or 2062.

Free and Cluster Electives
International Affairs majors are encouraged to use electives to tailor-fit the core education they receive with their own specific career and postgraduate objectives. Students are required to complete at least 12 hours of elective offerings in courses taught in the Sam Nunn School as well as a 15-hour non-major cluster taught outside the School.

Certificate Programs
The Sam Nunn School, often in conjunction with other units of the Ivan Allen College, administers three certificate programs. These programs enable students to pursue a focused program of study in a specific area of regional/international specialization or as preparation for a career in the legal world. The School awards the following certificates:
- Asian Affairs Certificate (available to majors and nonmajors)
- European Affairs Certificate (available to majors and nonmajors)
- International Affairs Certificate (available only to nonmajors)

The Sam Nunn School of Interntional Affairs also offers courses that are included in the Pre-Law Certificate awarded by the School of Public Policy.

A certificate is awarded upon successful completion of a predetermined 12-hour cluster of courses approved by the academic advisor or a specific faculty member. All courses must be taken on a letter-grade basis, and a grade of *C* or better must be received in each course. Certificates will be granted only to students who, in addition to the Certificate program requirements, have satisfied requirements for an undergraduate degree. Detailed information concerning these programs and their requirements is available through the School.

Minor Program
The School offers a minor in International Affairs. This program is designed for students who want a concentration outside of their major that provides a greater depth of study than a certificate program. The minor in international affairs requires a minimum of 18 hours of course work, including "Introduction to International Relations," one 2000-level course (not to include INTA 2010), and nine hours of upper-division (3000-level or higher) course work. No more than four hours of Special Topics course work may be included in the minor program. Special Problems courses may not

be included. All courses must be taken on a letter-grade basis, and a grade of *C* or better must be received in each course. Courses required by name and number in a student's major degree program may not be included. Detailed information concerning this program and its requirements is available through the School.

Graduate Program

The Master of Science in International Affairs degree program is an 18-month program that is adaptable to the interests and needs of a student who intends to immediately enter a professional career requiring advanced training in international affairs or who intends to continue studying at the doctoral level. The program emphasizes both traditional theoretical knowledge of international relations and strategic planning and analysis. The program includes core courses in:

- international relations theory and strategy;
- comparative politics;
- international political economy;
- international security;
- empirical research methods; and,
- modeling, forecasting, and decision making.

Students also have the opportunity to design the program to meet their individual interests through elective offerings in the School and inter-disciplinary work in the Schools of Economics and Public Policy; and the Colleges of Computing, Engineering, Management, and others. Overseas programs and internships are encouraged and facilitated by the School.

In addition to 36 semester hours of course work, students must demonstrate foreign language familiarity and economics and computer literacy. These abilities are essential tools for professional or scholarly work in international affairs. Students must satisfy these requirements upon admission or during the program.

Foreign language familiarity is defined as a minimum of one year of college-level work in a single language. This requirement can be fulfilled while in residence or can be demonstrated through an examination taken in the Department of Modern Languages.

Economics literacy is satisfied by successful completion of a course or courses in micro and macroeconomic principles and a course in international economics undertaken while at Georgia Tech or by successful completion of equivalent courses at another institution. Students who complete graduate-level courses in price theory (microeconomics) and national income analysis (macroeconomics) will both satisfy that portion of the literacy requirement and receive elective credit toward their degree.

Computer literacy is satisfied by either:

(1) successfully completing (*B* or higher) at least one semester of classes with content including at least one of the following:

- programming computers;
- database design and operation;
- spreadsheet development and operation;
- data analysis (if part of statistics courses, at least two quarters or two semesters);
- simulation model design and use;
- development and use of geographic information or cartography systems; or,
- operation of large computer systems/computer networks.

(2) Having held a job for at least six months in which a significant component of the work entailed one of the activities listed above.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

INTERNATIONAL AFFAIRS

INTA 1110. Introduction to International Relations
3-0-3.
An introduction to the major principles, concepts, actors, and theories of the international system and their application to current issues in world affairs.

INTA 1200. American Government in Comparative Perspective
3-0-3.
Examines American government in relation to other political and economic systems in countries around the world.

INTA 2010. Empirical Methods
3-0-3.
Develops skills in research design, model building, and hypothesis construction. Provides experience in using computer software programs to perform statistical tests including t-tests, chi-square, and regression.

INTA 2030. Ethics in International Affairs
3-0-3.
Surveys the main traditions and theories of international ethics with a focus on intervention and the use of force, human rights, self-determination, and global distributive justice.

INTA 2100. Theoretical Approaches to Great Power Relations
3-0-3. Prerequisite(s): INTA 1110
Juxtaposes competing explanations for the patterns of conflict and cooperation among nations, illustrated by relations among the great powers of Europe and Asia during the past two centuries.

INTA 2210. Comparative Political Philosophies and Ideologies
3-0-3.
Explores political ideologies and philosophies, including theories of democracy, capitalism, and socialism, as well as rival views of the "good society" in comparative and historical perspective.

INTA 2220. Government and Politics of Western Europe
3-0-3.
A comparative analysis of the politics and major institutions of the countries of contemporary Western Europe.

INTA 2230. Government and Politics of Asia
3-0-3.
An introduction to the major issues and aspects of the politics, societies, and cultures of East Asia, and the changing role of the region in international affairs.

INTA 3010. International Technology Transfer
3-0-3. Prerequisite(s): INTA 1110.
Explores the impact of technology transfer on key contexts such as economic development and the international diffusion of defense production and technology.

INTA 3030. Ethics, Technology, and Policy
3-0-3.
Explores pivotal issues involving ethics and technology in the private sector, government service, and in international organizations.

INTA 3101. International Institutions
3-0-3.
Scrutinizes the evolution of international institutions and juxtaposes competing theoretical approaches for understanding the changing roles and functions of institutions in world affairs.

INTA 3102. The Problem of Proliferation
3-0-3. Prerequisite(s): INTA 1110.
Explores the political and economic issues, both international as well as domestic, involved in the spread of weapons of mass destruction since the end of the Second World War.

INTA 3103. The Challenge of Terrorism
3-0-3.
Examines the contexts that nurture domestic and international terrorism, the variety of terrorist organizations, and alternative approaches to combating the problem.

INTA 3104. International Negotiations
3-0-3. Prerequisite(s): INTA 1110.
Examines the theories of bargaining and negotiation, with an emphasis on explaining success and failure in U.S. foreign policy and national security negotiations.

INTA 3110. U.S. Foreign Policy
3-0-3. Prerequisite(s): INTA 1200 or HIST 2111 or HIST 2112 or POL 1101 or POL 1102
Analyzes the formulation and implementation of America's foreign policy from 1914 to the present, stressing economic, political, and strategic factors.

INTA 3111. U.S. Defense Policy
3-0-3.
Examines contemporary American defense policy, including the formulation of strategy, the defense budget, force structure, and nontraditional uses of military force.

INTA 3120. European Security Issues
3-0-3. Prerequisite(s): INTA 1110.
Explores the contemporary European security environment including threats, challenges, and various security architectures (e.g., NATO, the WEU, and the OSCE).

INTA 3130. Foreign Policy of China
3-0-3.
Analyzes the major dimensions of the foreign policies of the People's Republic of China and the domestic and international influences shaping those policies.

INTA 3131. Pacific Security Issues
3-0-3. Prerequisite(s): INTA 1110.
Examines past, present, and future security concerns in the Pacific, including the Korean peninsula, Japanese defense, the emergence of China as a military power, and the forward basing of American troops and materiel.

INTA 3201. Political Geography
3-0-3. Prerequisite(s): INTA 1110.
Explores geopolitics, the rise and fall of great powers, imperialism, nationalism, nation-states, and elections through the use of geographic scales, regions, and place-specific contexts.

INTA 3203. Comparative Politics
3-0-3. Prerequisite(s): INTA 1200 and INTA 2010.
Contrasts competing theoretical perspectives in the comparative analysis of political systems.

INTA 3220. Government and Politics of Germany
3-0-3.
Examines the government and politics of Germany with an in-depth focus on the post-1945 period. NOTE: When taught jointly with the Department of Modern Languages, all lectures, assignments, and readings are in German.

INTA 3230. Government and Politics of China
3-0-3.
Investigates the structure and institutions of political power as well as the patterns and features of political change in the contemporary People's Republic of China.

INTA 3231. Government and Politics of Japan
3-0-3.
Examines the main institutions, policies, and politics of contemporary Japan. Investigates the impact of social, cultural, and economic forces on Japan's government and politics.

INTA 3240. Government and Politics of Africa
3-0-3.
A survey of the history, cultures, social systems, governments, economies, and international roles of Africa. Selected case studies of individual countries are presented.

INTA 3301. International Political Economy
3-0-3. Prerequisite(s): INTA 1110.
Analyzes the relationship between political and economic issues in international affairs. Examines the interaction of states and markets in the context of trade, investment, and production.

INTA 3302. International Money, Finance, and Fiscal Policy
3-0-3. Prerequisite(s): INTA 3301.
Examines the politics of macroeconomic policy choice in a world of increasingly integrated financial markets. Topics include the causes and consequences of increasing capital mobility, tax competition, and G-7 macroeconomic policy coordination.

INTA 3303. Political Economy of Development
3-0-3.
Surveys theories of economic development and political change, and examines a range of cases that include the European-American experience, the East Asian episode, and the transition from socialism.

INTA 3304. International Trade and Production
3-0-3. Prerequisite(s): INTA 3301.
Examines the political economy of international trade and the global production process with particular emphasis on conflict and cooperation in national competition for high-technology industries.

INTA 3321. Political Economy of European Integration
3-0-3.
Explores the processes and problems of political and economic integration in the European Union, the world's largest trading bloc.

INTA 3330. Political Economy of China
3-0-3.
Examines the centuries of stagnation and the recent rapid growth of the Chinese economy, and seeks to understand the current interaction between politics and economic development in the People's Republic of China.

INTA 3331. Political Economy of Japan
3-0-3.
Surveys the political foundations and economic achievements of modern Japan. Explores the interaction of domestic and international forces, and analyzes Japan's changing world role.

INTA 3750. International Language Policies
3-0-3. Prerequisite(s): INTA 1110
An introduction to the politics, problems, and alternative solutions in national language choices, including a comparative analysis of industrialized and developing nations. Crosslisted with LING 3750.

INTA 3801,-2,-3. Special Topics
3-0-3, each.
Selected topics will vary from term to term.

INTA 4010. Science, Technology, and International Affairs
3-0-3. Prerequisite(s): INTA 1110 and INTA 2010.
Explores the impact of science and technology on the international system as well as the role of politics and economics in the development and use of technology.

INTA 4011. Technology and Military Organization
3-0-3.
Addresses the impact of technological developments on the evolution of military organization and on international conflict from the Battle of Agincourt (1415) to the Gulf War (1991).

INTA 4121. Seminar in Europe: European Security
3-0-3.
Examines the history, institutional structure, and functions, as well as current policy challenges facing NATO and other European security arrangements.

INTA 4230. Seminar in Europe: European Union
3-0-3.
Explores the history and processes of economic and political integration within the framework of the European Union.

INTA 4400. Senior Seminar: International Strategy and Policy
3-0-3.
Capstone experience in which students formulate strategies and policies to cope with international problems. Themes vary from seminar to seminar.

INTA 4801,-2,-3. Special Topics
3-0-3, each.
Selected topics will vary from term to term.

INTA 4901,-2,-3. Special Problems
Credit hours to be arranged.
Independent study with a faculty member.

INTA 6002. Strategic Decision Making
3-0-3.
Examines the dynamics of individual, group, organizational, cross-cultural, and international interaction.

INTA 6003. Empirical Research Methods
3-0-3.
This course introduces research methods in international affairs. It emphasizes writing research proposals, empirical techniques, gathering and assembling data, and methods for analyzing and reporting results.

INTA 6004. Modeling, Forecasting, and Decision Making
3-0-3.
This course introduces modeling and forecasting in strategic decision making, analysis of long-term developments, path gaming, formal analysis of games, and simulation.

INTA 6011. International Trade and Technology Transfer
3-0-3.
This course examines the relationship between international trade and technology transfer and their effect on national competitiveness, national security, and international cooperation and coercion.

INTA 6013. Technology Forecasting
3-0-3.
Increasingly rapid technological changes impact international relations in various aspects. This course utilizes qualitative and quantitative methods in assessing the direction and magnitude of such changes.

INTA 6022. Ethics and International Affairs
3-0-3.
An overview of the main tradition and theories of international ethics applied to four major issues: intervention and the use of force; human rights; self-determination; and global distributive justice.

INTA 6102. International Relations Theory
3-0-3.
This course provides an introduction to theoretical approaches to understanding international relations. The focus of the course is on system-level theories and sub-systematic-level theories.

INTA 6103. International Security
3-0-3.
Examines traditional and nontraditional issues in international security, including the uses of military force, military strategy and policy, arms control, peacekeeping, the environment, and migration.

INTA 6104. The Changing World Order
3-0-3.
As a seminar for graduate students, this course explores the issues of world order conceptually and empirically. Various political organizations and the major proposals for the world order are critically examined.

INTA 6105. International Institutional Design
3-0-3.
This course examines international institutions and their effect on foreign policy decision makers. Specific topics include: the theoretical study of cooperation, supranatural organizations, and informal institutions.

INTA 6106. The State in International Affairs
3-0-3.
Explores various concepts of the state in international affairs as well as the concepts of sovereignty and revolution.

INTA 6107. Development and Demography
3-0-3.
This course examines the role population plays in the development of countries and the international system.

INTA 6111. U.S. Foreign and National Security Strategy
3-0-3.
This course focuses on the design and implementation of U.S. foreign policy and national strategy in the areas of arms control, the Third World, and economic policy.

INTA 6121. Seminar In Europe: European Security
3-0-3.
This course examines the history, institutional structure and functions, and current policy challenges facing the North Atlantic Treaty Organization (NATO) and other European security institutions.

INTA 6202. Comparative Politics
3-0-3.
This course surveys the major political types of the late 20th century world and explores their various development characteristics.

INTA 6203. Comparative Institutional Design
3-0-3.
This course examines the creation, maintenance, and evolution of political institutions, and the ways in which institutions affect policy choice.

INTA 6204. Comparative Politics and Strategies of Advanced Industrial Sites
3-0-3.
This course provides an in-depth assessment of the political and economic behavior of the five largest OECD powers.

INTA 6205. Literacy and Development
3-0-3.
This course analyzes the politics, problems, and alternative solutions in national language choices, including a comparative analysis of industrialized and developing nations.

INTA 6302. International Political Economy
3-0-3.
This course is an introduction to the politics of international economic relations. Major theoretical approaches are applied to international trade, international monetary relations, and global production in the modern era.

INTA 6303. Economic Crisis and Democratization
3-0-3.
This course examines the complex relationship between economic transitions and political reform in authoritarian and newly democratic countries.

INTA 6304. Modernization and Development
3-0-3.
This course empirically examines processes in which a country's organizational structure is altered through economic development, political democratization, and/or social liberalization.

INTA 6305. Political Economy of Foreign Direct Investment
3-0-3.
This course examines the impact of foreign direct investment on the world economy and international trade, as well as the political effects of multinational corporations.

INTA 6320. Seminar in Europe: European Union
3-0-3.
This course explores the history and processes of economic and political integration within the framework of the European Union.

INTA 6330. Political Economy of East Asia
3-0-3.
This course explores the politics of economic development in China, Japan, and Korea. Focal issues include: trade patterns, financial institutions, trade-bloc formation, industrial competitiveness and the status of U.S.-East Asian economic relations.

INTA 6331. Chinese Political Economy
3-0-3.
This course examines Chinese social and economic development from the 7th century to current day. Specific emphasis is placed on the political economic reforms of Deng Xiaoping and assessing the implications of continued Chinese modernization.

INTA 6753. Comparative Science and Technology Policy
3-0-3.
Examination of the social, political, and cultural contexts of science and technology, and how they affect the research, development, and regulatory policies of nations. Crosslisted with PUBP 6753.

INTA 7000. Master's Thesis
Credit hours to be arranged.
Under the direct supervision of one or more faculty members, graduate students will complete an original research design and execute that study.

INTA 8801,-2,-3,-4,-5. Special Topics
Credit and class hours equal last digit of course number.

INTA 8901,-2,-3. Special Problems
Credit hours to be arranged.

INTA 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students with a teaching assistantship.

INTA 8998. Research Assistantship
Credit hours to be arranged.
For graduate students with a research assistantship.

School of Literature, Communication, and Culture

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Chair and Associate Professor–Richard A. Grusin; *Associate Chair and Associate Professor*–Alan Rauch; *Director of Graduate Studies and Associate Professor*–Philip Auslander; *Director of Undergraduate Studies and Associate Professor*–Sandra Corse; *Professor Emeritus*–Maxine Turner; *Wesley Professor of New Media*–Jay David Bolter; *Professors*–Kenneth Knoespel, Peter McGuire, Jay P. Telotte; *Associate Professors Emeriti*–Edith H. Blicksilver, Sarah E. Jackson; *Associate Professors*–Anne M. Balsamo, James J. Bynum, Carol A. Colatrella, T. Hugh Crawford, Blake T. Leland, Matthew O'Brien, Sara M. Putzell, Carol Senf, Robert E. Wood; *Assistant Professors*–Matthew D. Causey, Deborah R. Grayson, Terence A. Harpold, TyAnna K. Herrington, Rebecca B. Merrens, Daryl S. Ogden, Joseph Petraglia-Bahri, Kavita Philip, Michele Shauf, Ellen Strain, Greg VanHoosier-Carey, Paul Young; *Visiting Assistant Professors*–Michael Merrill, Kim VanHoosier-Carey; *Brittain Fellows*–Suzanne Black, Dan Cabaniss, Shannon Dobranski, Mark Frankel, Lisa Haefele, Lissa Holloway-Attaway, Heather Huddleston, Brian Loftus, Andrew McMurry, Miriam Moore, Alexander Reid, Patrick B. Sharp, Laura Tuley, Angela Wall; *Research Scientist*–Ute Fischer; *Director of LCC Continuing Education*–Thomas Winn; *Director of DramaTech*–Gregory Abbott.

General Information

The School of Literature, Communication, and Culture (LCC) is engaged in rethinking the role of humanities education in an increasingly technological and multicultural environment. The faculty is committed to interdisciplinary research in cultural studies and new media studies at the theoretical and applied levels. In providing humanities and communication courses for all Georgia Tech undergraduates, LCC's curriculum focuses on the scientific and technologically oriented aspects of the humanities as well as on the incorporation of new electronic media (visual, aural, and textual) into humanities and communication education.

LCC offers a B.S. in Science, Technology, and Culture (STAC) and an M.S. in Information Design and Technology (IDT). Graduates from LCC's undergraduate and graduate programs are positioned to assume important roles as leaders in the exciting new fields developing in the interface between technology and culture. STAC majors receive a rigorous, well rounded education that equips them not only for careers in government, education, and the private sector, but also for postgraduate study in medicine, law, communication, or cultural studies. In addition they find themselves well prepared for the continual learning necessary for their future lives and careers. Most IDT graduates accept positions of responsibility in new media-related careers as web designers, project managers, new media developers, and educational technologists. Some IDT graduates go on to Ph.D. programs in computing, media studies, communication, and related fields.

Undergraduate Program

Bachelor of Science in Science, Technology, and Culture (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION 1	3
MATH 1501 or MATH 1712		4
LAB SCIENCE (CHEM, BIOL, PHYS, EAS)		4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		14

First Year - Spring Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502 or MATH 1711		4
LAB SCIENCE (CHEM, BIOL, PHYS, EAS)		4
CS 1301	COMPUTER SCIENCE I	3
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS		16

Second Year - Fall Semester

Course Number/Name		*Hours*
LCC 2100	INTRO. TO STAC	3
SOCIAL SCIENCE ELECTIVE		3
HUMANITIES ELECTIVE		3
ML ELECTIVE		3
SCIENCE or COMPUTER SCIENCE ELECTIVE		4
TOTAL SEMESTER HOURS		16

Second Year - Spring Semester

Course Number/Name	*Hours*
PST 3115 or 3127	3
SOCIAL SCIENCE ELECTIVE	3
HUMANITIES ELECTIVE	3
SOCIAL SCIENCE ELECTIVE (INTERNATIONAL)	3
SCIENCE OR COMPUTER SCIENCE ELECTIVE	4
TOTAL SEMESTER HOURS	16

Third Year - Fall Semester

Course Number/Name	*Hours*
LCC 21XX ELECTIVE	3
LCC 22XX/32XX ELECTIVE	3
LCC 34XX ELECTIVE	3
FREE ELECTIVE	3
NON-MAJOR CLUSTER	3
TOTAL SEMESTER HOURS	15

Third Year - Spring Semester

Course Number/Name	*Hours*
LCC 21XX ELECTIVE	3
LCC 22XX/32XX ELECTIVE	3
LCC 33XX ELECTIVE	3
LCC 34XX ELECTIVE	3
NON-MAJOR CLUSTER	3
TOTAL SEMESTER HOURS	15

Fourth Year - Fall Semester

Course Number/Name	*Hours*
LCC 22XX/42XX ELECTIVE	3
LCC 33XX ELECTIVE	3
LCC ELECTIVE	3
NON-MAJOR CLUSTER	3
FREE ELECTIVE	3
TOTAL SEMESTER HOURS	15

Fourth Year - Spring Semester

Course Number/Name	*Hours*
LCC 34XX/44XX ELECTIVE	3
LCC 33XX ELECTIVE	3
LCC ELECTIVE	3
LCC 4100 or 4102	3
FREE ELECTIVE	3
TOTAL SEMESTER HOURS	15

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HRS)

Requirements and Electives

Requirements of the Bachelor of Science in Science, Technology, and Culture:

Basic Distribution	59 hours
Major Hours	45 hours
Non-major Cluster	9 hours
Free electives	9 hours
TOTAL	122 hours

Basic Distribution/Core Requirements

Freshman Composition	6 hours
Mathematics	8 hours
Laboratory Science	8 hours
Computing	3 hours
Science or Computing	8 hours
Humanities and Fine Arts	6 hours
Social Sciences	12 hours
----HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200	
----an internationally oriented course from an approved list	
----two additional social science courses	
Modern language at the 2000 level or higher	3 hours
Philosophy of Science	3 hours
----PST 3115 or 3127	
Wellness Course	2 hours
----HPS 1040 or 1061	

Mathematics
The mathematics requirement may be satisfied by one of the following sequences: MATH 1711 and 1712 or MATH 1501 and 1502.

Science and Computing
The laboratory science sequence may be satisfied with any two lab science courses offered in chemistry, biology, physics, or earth and atmospheric sciences. Courses need not form a sequence. All Georgia Tech students are required to take CS 1301. In addition, STAC majors must take eight additional hours in science or computing.

Freshman Composition/Humanities/ Fine Arts
Students are required to complete six hours in humanities or fine arts in addition to six hours in freshman composition (ENGL 1101 and 1102), for a total of 12 hours.

Social Sciences
Students are required to complete 12 hours of social science credit. These include (a) one course from HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200 to satisfy state requirements concerning course work on the history and Constitutions of the U.S. and Georgia; (b) one course with an international focus; and (c) two additional social science courses.

Health and Performance Sciences
Students are required to take a two-hour wellness course, HPS 1040 or HPS 1061. No student may receive credit for more than three hours of physical education toward the degree.

Non-Major Cluster
All students must take a nine-hour concentration from a unit other than Literature, Communication, and Culture. This requirement may be met through an existing certificate program or by a nine-hour concentration approved by LCC and meeting the following requirements: (1) all courses must be above the required courses and distribution requirements in the course curriculum, (2) all courses must be either in one discipline or part of an interdisciplinary cluster grouped around a particular topic; and (3) the cumulative average for the concentration must be at least 2.0.

Designated Courses in the Major
All students must take 42 hours of STAC courses including the following groups:
(1) LCC 2100;
(2) Six hours of STAC historical courses (LCC 2102, 2104, 2106, 2108, 2110, 2112, 2114, 2116, 2118);
(3) Nine hours of STAC literary/cultural courses (LCC 2202, 2204, 2206, 2208, 2210, 2212, 2214, 2216, 2218, 3202, 3204, 3206, 3208, 3210, 3212, 3214, 3216, 3218, 3220, 3222, 3224, 3226, 3252, 3254, 3256, 3262, 4200, 4600);
(4) Nine hours of STAC issues courses (LCC 3302, 3304, 3306, 3308, 3310, 3314, 3316, 3318, 3352, 3362, 3364); and
(5) Nine hours of STAC media/communications courses (LCC 3402, 3404, 3406, 3408, 3410, 3412, 4400, 4402, 4404, 4406); and
(6) Two additional STAC (LCC) courses.

With the permission of the School, a student may substitute up to six hours of LCC special topics courses for any of these courses except LCC 2100.

Senior Seminars/Thesis
Each student must complete a senior seminar (LCC 4100) or senior thesis (LCC 4102). A student must have a signed contract with a thesis advisor in order to receive permission to register for thesis credit.

Free Electives
Each student must accumulate at least 122 hours of credit toward the Bachelor of Science in Science, Technology, and Culture. Therefore, in addition to the requirements listed here, a student must complete a sufficient number of elective courses either within or outside LCC to complete 122 hours. Typically, this will be nine hours.

Minors and Certificates
LCC provides a minor in Performance Studies and, together with the School of History, Technology, and Society (HTS), provides a minor in Women, Science, and Technology (WST). Students wishing to pursue either of these minors should consult LCC (or, in the case of the WST minor, either LCC or HTS) for detailed information concerning requirements. Courses for both minors are selected from among those listed below and, in the case of the WST minor, in the list offered by HTS.

LCC and HTS also cooperate in providing a certificate in African-American Studies. Students should consult LCC or HTS for detailed information concerning requirements. Courses for this certificate are selected from among those listed below and from the list offered by HTS.

Advanced Placement
Students with a score of 4 or 5 on the College Board Advanced Placement Exam (taken in conjunction with high school classes) in Composition and Literature or Language and Composition receive credit for English 1101. Students with a score of 750 or higher on the SAT II Subject Test in English receive credit for English 1101. Students with a score of 4 or higher on the International Baccalaureate Exam receive credit for English 1101. Advanced placement credit is not ordinarily given for English 1102.

Writing and Communication Intensive Courses
A number of majors require students to complete writing intensive and communication intensive courses. Several LCC classes may be counted toward this requirement. Consult course offerings each semester to determine which courses may be counted toward this requirement.

Regents' Examination
This exam measures proficiency in reading and English composition; a passing score is required by the Board of Regents for graduation. Students who have not passed the exam by the time they have completed 45 hours of degree credit must schedule ENGL 0012 or 0015 in their next semester in residence. In addition to ENGL 0012 and 0015, LCC offers short workshops in preparation for the exam, consultation with those who have failed, and an appeal system for those who fail.

Graduate Programs

Master of Science in Information Design and Technology
The 21st century presents complex, exciting challenges in new media and information technology. The Master of Science in Information Design and Technology (IDT) prepares students to work with the communication technologies that will shape the culture of the 21st century.

The M.S. program in IDT provides students with the opportunities to use tools in electronic and digital communication through classes in digital video production, web development, graphic design, and multimedia. Students also learn theoretical approaches to the critical assessment of new media by taking seminars in cultural, historical, and cognitive analysis of new media and information technologies.

New students are admitted in the fall semester; admission is limited to 20 full-time students. Each student takes a minimum of four courses each semester while actively participating in the other educational and research activities of the program. LCC provides extensive computer and video facilities, and students have access to high-end computing facilities in LCC's Center for New Media Education and Research and Georgia Tech's interdisciplinary Center for Graphics, Visualization, and Usability.

The effectiveness of the program depends on its ability to engage students in both practical and analytical work from a variety of disciplinary and cultural perspectives. Consequently, the program seeks applications from students with backgrounds in the humanities, social sciences, natural and physical sciences, computing, or engineering, as well as in communication. Applications are also encouraged from international students and minorities.

NOTE: For specific admissions requirements, contact the director of Graduate Studies.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

ENGLISH

ENGL 0012. Writing the Impromtu Essay
2-0-2.
Gives special attention to development of basic skills in writing for students who need additional preparation for the University System Regents' Exam. Cannot be counted for credit toward graduation.

ENGL 0015. Reading Comprehension
2-0-2.
Special attention given to developing reading skills for students who need additional preparation for the University System Regents' Exam. Cannot be counted for credit toward graduation.

ENGL 1101. English Composition I
3-0-3.
Develops analytical reading and writing skills through the investigation of methods used in cultural and literary studies and the application of those methods to specific texts.

ENGL 1102. English Composition II
3-0-3. Prerequisite(s): ENGL 1101.
Develops communication skills in networked electronic environments, emphasizes interpretation and evaluation of cultural texts, and incorporates research methods in print and on the Internet.

LITERATURE, COMMUNICATION, AND CULTURE

LCC 2100. Introduction to Science, Technology, and Culture
3-0-3. Prerequisite(s): ENGL 1102.
As the introductory course to the major in science, technology, and culture, this course explores the ways in which disciplines construct and represent the knowledge they generate.

LCC 2102. Science, Technology, and the Classical Tradition
3-0-3. Prerequisite(s): ENGL 1102
Explores the definition and transmission of science and technology within Greek, Arabic, and medieval Latin contexts.

LCC 2104. The Age of Scientific Discovery
3-0-3. Prerequisite(s): ENGL 1102.
Examines the relationships among texts representing the literary, artistic, and scientific thought of the 15th and 16th centuries.

LCC 2106. The Age of Scientific Revolution
3-0-3. Prerequisite(s): ENGL 1102.
Examines interrelation of technological, literary, artistic, and philosophical thought in the late 16th and 17th centuries.

LCC 2108. Science, Technology, and Enlightenment
3-0-3. Prerequisite(s): ENGL 1102.
Considers the conceptual reformulation of the internal and external world urged by the sciences, technology, and culture of the Enlightenment.

LCC 2110. Science, Technology, and Romanticism
3-0-3. Prerequisite(s): ENGL 1102.
Examines the relationships among romantic ideology, science, and literature, including Romanticism's imaginative responses to Enlightenment science and the Industrial Revolution.

LCC 2112. Evolution and the Industrial Age
3-0-3. Prerequisite(s): ENGL 1102.
Connects later 19th-century scientific and technological concepts and discoveries, particularly theories of evolution, to the literature and culture of the industrial age.

LCC 2114. Science, Technology, and Modernism
3-0-3. Prerequisite(s): ENGL 1102.
Explores a cross section of technological, scientific, and cultural production characteristics of the first half of the 20th century.

LCC 2118. Science, Technology, and American Empire
3-0-3. Prerequisite(s): ENGL 1102.
Considers 19th and 20th century science and technology as they shaped American culture, with particular attention to the relationship between science, technology, progress, and empire.

LCC 2202. Ancient and Medieval Literature and Culture
3-0-3. Prerequisite(s): ENGL 1102.
Introduction to Greece, Rome, and Medieval Europe through an examination of one or a few major cultural conflicts expressed in the literary genres and periods.

LCC 2204. Renaissance Literature and Culture
3-0-3. Prerequisite(s): ENGL 1102.
An examination of literature and culture from 1450 to 1650 with an emphasis on both major achievements and divergent voices.

LCC 2206. Enlightenment Literature and Culture
3-0-3. Prerequisite(s): ENGL 1102.
Examines the nature of the age from an initial boldness, optimism, and faith in reason to a recognition of its limits.

LCC 2208. Formations of American Culture
3-0-3. Prerequisite(s): ENGL 1102.
American literature from the Puritan period through the Civil War, including major movements, key authors and texts, study of literary works within broader historical and cultural context.

LCC 2210. Rearticulations of American Culture
3-0-3. Prerequisite(s): ENGL 1102.
Examines representations of the USA from its geographical expansion in the late 19th century to the closing of the frontier and emergence as a global power.

LCC 2212. British and Continental Romanticism
3-0-3. Prerequisite(s): ENGL 1102.
Examines British and Continental Romanticism as it appeared during the latter part of the 18th century and the first half of the 19th century.

LCC 2214. Victorian Literature and Culture
3-0-3. Prerequisite(s). ENGL 1102.
Investigates the period 1830-1901 in English literature and culture, focusing on how that period defined key questions, especially ones about human nature, society, and the relation of religion to science.

LCC 2216. Literary and Cultural Modernism
3-0-3. Prerequisite(s): ENGL 1102.
A partial investigation of the aesthetic ferment that characterizes English-language cultural production from the turn of the century to the end of World War II.

LCC 2218. Literary and Cultural Postmodernism
3-0-3. Prerequisite(s): ENGL 1102.
A survey of major themes, representational techniques, and social and cultural concerns of postmodern art and literature.

LCC 2400. Introduction to Media Studies
3-0-3. Prerequisite(s): ENGL 1102.
This course offers an introduction to the historical development and cultural impact of various forms of media: print, radio, television, film, and interactive electronic applications.

LCC 2500. Introduction to Film
3-0-3. Prerequisite(s): ENGL 1102.
Introduces film techniques and vocabulary in an historical and cultural context. Written texts are supplemented by viewings of specific shots, scenes, episodes, and films.

LCC 2600. Introduction to Performance Studies
3-0-3. Prerequisite(s): ENGL 1102.
An examination of the origins of the field of performance studies in literary study of theater and drama, anthropological investigations of ritual, and sociological analyses of performance in everyday life.

LCC 2661. Theater Production: Set Design and Construction
0-3-1. Prerequisite(s): ENGL 1102.
In this "hands-on" course, students learn theatrical construction and painting techniques while building scenery for DramaTech productions.

LCC 2662. Theater Production II: Lights, Properties, Costumes
0-3-1. Prerequisite(s): ENGL 1102.
In this "hands-on" course, students create the lighting, property, and costume effects for two DramaTech productions.

LCC 2813. Special Topics in Science, Technology, and Culture
3-0-3. Prerequisite(s): ENGL 1102.
Study of one or more topics of current interest in the area of science, technology, and culture.

LCC 2823. Special Topics in Literary and Cultural Studies
3-0-3. Prerequisite(s): ENGL 1102.
Examines one or more topics of current interest in literary and cultural studies.

LCC 3202. Studies in Fiction
3-0-3. Prerequisite(s): ENGL 1102.
Examines the elements of fiction and what has made fiction, especially the novel, distinctive, popular, and enduring. Readings may include formal, cultural, and historical theories.

LCC 3204. Poetry and Poetics
3-0-3. Prerequisite(s): ENGL 1102.
A study of traditions of poetic practice and poetic theory in English, in conjunction with a weekly workshop session centered on student's own poetry.

LCC 3206. Studies in Communication and Culture
3-0-3. Prerequisite(s): ENGL 1102.
Examines ways in which forms and media of communication create and are created by other cultural constructs.

LCC 3208. African-American Literature and Culture
3-0-3. Prerequisite(s): ENGL 1102.
Explores the works of African-American writers from the Colonial period to the present and examines a variety of cultural constructs that have fundamentally shaped the African-American literary tradition.

LCC 3210. Ethnicity in American Culture
3-0-3. Prerequisite(s): ENGL 1102.
Explores literary and historical works considering ethnic issues in American culture, including immigration, social assimilation, "double consciousness," the development of ethnic identity/pride, and multiculturalism.

LCC 3212. Women, Literature, and Culture
3-0-3. Prerequisite(s): ENGL 1102.
Students in this course will analyze writings by women and examine feminist and other relevant cultural critiques of literature.

LCC 3214. Science Fiction
3-0-3. Prerequisite(s): ENGL 1102.
Examines science fiction texts from the last 200 years to show how they reflect ambiguous reactions to change.

LCC 3216. Theater I: Classic and Medieval
3-0-3. Prerequisite(s): ENGL 1102.
The dramatic literature, theory, performance practices, and historical and cultural context of the theater from prehistory through the Medieval period.

LCC 3218. Theater II: Renaissance-Restoration
3-0-3. Prerequisite(s): ENGL 1102 .
The dramatic literature, theory, performance practices, and historical and cultural context of theater from the Renaissance through Restoration.

LCC 3220. Theater III: Modern-Contemporary
3-0-3. Prerequisite(s): ENGL 1102.
The dramatic literature, theory, performance practices, and historical and cultural contexts of the theatre from Modernism to our contemporary period.

LCC 3222. Regionalism in American Literature
3-0-3. Prerequisite(s): ENGL 1102.
Explores the literary and cultural representations of a particular American region or locale (the South, the West, California, New York City, etc.) and the role such representations have played in the formation of both regional and national identity.

LCC 3224. Gender Studies
3-0-3. Prerequisite(s): ENGL 1102.
Considers the cultural concept of gender and its usefulness as a theoretical category in a variety of disciplines. Includes cultural studies of literature, communication media, cultural anthropology, sociology, history, and science.

LCC 3226. Major Authors
3-0-3. Prerequisite(s): ENGL 1102.
An examination of the works and career of a major author in historical and cultural context.

LCC 3252. Studies in Film and Television
3-0-3. Prerequisite(s): LCC 2400 or LCC 2500.
Explores in depth a theoretical issue central to film and/or television. Among its concerns are authorship, genre theory, spectatorship, ideology, narrative theory, and the relationship between these media and social history.

LCC 3254. Film History
3-0-3. Prerequisite(s): LCC 2500.
Surveys the history of film from its machine origins to its present digital developments. It focuses on various movements, figures, and narrative developments in world cinema.

LCC 3256. Major Filmmakers
3-0-3. Prerequisite(s): LCC 2500.
Traces in depth an individual artist's career and affords students the opportunity to immerse themselves in the works of an important figure in the world of film.

LCC 3262. Performance Studies
3-0-3. Prerequisite(s): LCC 2600.
An examination of cultural theories of performance and their application to the analysis of specific performative events.

LCC 3302. Science, Technology, and Ideology
3-0-3. Prerequisite(s): ENGL 1102.
Examines specific scientific, philosophical, and literary/cultural texts in order to determine the role ideology plays in the construction of culture, especially scientific and technological culture.

LCC 3304. Science, Technology, and Gender
3-0-3. Prerequisite(s): ENGL 1102.
Examines specific philosophical, scientific, and cultural texts to determine the role that gender has played in scientific and technological knowledge, currently and historically.

LCC 3306. Science, Technology, and Race
3-0-3. Prerequisite(s): ENGL 1102.
Examines specific historical and contemporary construction of race, within the prevailing scientific theories and ideologies in order to determine the role played by "race" in scientific and technological culture.

LCC 3308. Environmentalism and Ecocriticism
3-0-3. Prerequisite(s): ENGL 1102.
Surveys the emergence of ecocriticism as an analytical framework for interpreting the verbal and visual rhetorics of environmentalism in both western and non-western cultures.

LCC 3310. The Rhetoric of Scientific Inquiry
3-0-3. Prerequisite(s): ENGL 1102.
This course takes as its subject the ways in which argumentative and persuasive discourse is used to create and disseminate scientific knowledge.

LCC 3314. Technologies of Representation
3-0-3. Prerequisite(s): ENGL 1102.
Explores historical, cultural, and theoretical issues raised by technologies of representation, including written, spoken, and gestural languages, print, painting and illustration, still and moving photography, recorded sound, and computer-mediated communications and interactive digital media.

LCC 3316. Science, Technology, and Post-colonialism
3-0-3. Prerequisite(s): ENGL 1102.
Surveys the development of Postcolonial literary theory and historiography in order to analyze the interdependent discourses and practices of post-Enlightenment science/technology and European imperialism.

LCC 3318. Biomedicine and Culture
3-0-3. Prerequisite(s): ENGL 1102.
Discusses the history of biology and medicine, popular representations of health, disease, and the medical establishment, and the cultural implications of medical imaging technologies.

LCC 3352. Film and/as Technology
3-0-3. Prerequisite(s): LCC 2500.
Examines the development of film technology and the implications of that technology for cinema's treatment of technology.

LCC 3362. Science, Technology, and Performance
3-0-3. Prerequisite(s): LCC 2600.
Examines contemporary theories of performance in relation to the production of scientific knowledge and technologies of representation.

LCC 3400. Concepts and Principles in Technical Communication
1-0-1. Prerequisite(s): ENGL 1102.
Exposes students to the concepts and principles that drive technical communication. Students will learn about technical communication by studying principles that influence this genre of document production.

LCC 3402. Graphic and Visual Design
3-0-3. Prerequisite(s): LCC 2100 or LCC 2400.
Introduction to fundamentals of graphic and visual design of print and digital media. Familiarity with use of the World Wide Web, page layout, and computer graphic software recommended.

LCC 3404. Designing for the Internet
3-0-3. Prerequisite(s): LCC 2100 or LCC 2400.
An introduction to the theory and practice of effective communication on the Internet through the design of documents for the World Wide Web.

LCC 3406. Video Production
3-0-3. Prerequisite(s): LCC 2100 or LCC 2400.
An introduction to video production including basic skills in storyboarding, scripting, filming, editing, and sound.

LCC 3408. The Rhetoric of Technical Narratives
3-0-3. Prerequisite(s): LCC 2100.
Focuses on the rhetorical problems posed by such narrative documents as technical proposals, recommendations, reports, grant proposals, and marketing studies. Emphasis on document design, graphics, navigation systems, and editing.

LCC 3410. The Rhetoric of Non-Linear Documents
3-0-3. Prerequisite(s): LCC 2100
Focuses on the rhetorical problems posed by hypertext documents. Emphasis in designing for multiple audiences, page and document design, and navigation in a non-linear environment.

LCC 3412. Communicating Science and Technology to the Public
3-0-3. Prerequisite: LCC 2100.
Examines both the theoretical and practical issues involved in communicating scientific and/or technological material to a variety of lay audiences.

LCC 3661. Theater Production III: Management
0-3-1. Prerequisite: ENGL 1102.
In this "hands-on" course, students will create and execute a publicity campaign and operate the box office for DramaTech productions.

LCC 3662. Theater Production IV: Acting
0-3-1. Prerequisite: ENGL 1102.
This course provides students with an opportunity to perform onstage in a production at DramaTech. Auditions are required.

LCC 3823. Special Topics in Literature and Culture
3-0-3. Prerequisite: ENGL 1102.
Examination of one or more topics of current interest in literary and cultural studies.

LCC 3833. Special Topics in Issues of Science, Technology, and Culture
3-0-3. Prerequisite(s): ENGL 1102.
Study of one or more current issues in science, technology, and culture.

LCC 3843. Special Topics in Communication
3-0-3. Prerequisite(s): ENGL 1102.
Examines one or more topics of current interst in communication studies.

LCC 3853. Special Topics in Film
3-0-3. Prerequisite(s): LCC 2500.
Examines one or more current topics in film studies.

LCC 3863. Special Topics in Performance
3-0-3. Prerequisite(s): LCC 2600.
Examination of one or more topics of current interest in performance studies.

LCC 4100. Seminar in Science, Technology, and Culture
3-0-3. Prerequisite(s): LCC 2100.
A capstone seminar to the major, this course will ask students to draw upon their training in order to engage topical issues in the cultural studies of science.

LCC 4102. Senior Thesis
3-0-3. Prerequisite(s): LCC 2100.
Preparation for and writing of a thesis through faculty-directed independent study.

LCC 4200. Seminar in Literary and Cultural Theory
3-0-3. Prerequisite(s): ENGL 1102
Concentration on a single literary or cultural theorist and/or a major school of literary or cultural theory. Schools of theory that will be considered include, among others, Materialist, Feminist, Structuralist, Post-Structuralist, and Cultural Studies.

LCC 4400. Seminar in Media Studies
3-0-3. Prerequisite: LCC 2400.
Offers an in-depth investigation of the historical development and cultural impact of different forms of media including television, film, and interactive electronic applications.

LCC 4402. Basics of Multimedia Design
3-0-3. Prerequisite: ENGL 1102.
Introduces students to client and user needs and technology assessments, the interactive design process, and to creation of proof-of-concept applications using Macromedia Director.

LCC 4404. Advanced Design and Production
3-0-3. Prerequisite: LCC 4402.
Intensive studio course dealing with advanced concepts and techniques of the design and production of interactive multimedia.

LCC 4406. Contemporary Issues in Professional Communication
3-0-3. Prerequisite(s): ENGL 1102.
Intended primarily for students planning careers in professional communication, this course will alternate among a number of issues including intellectual property law, integrating print and electronic media, and cultural studies of corporate environments.

LCC 4600. Seminar in Performance Studies
3-0-3. Prerequisite(s): LCC 2600.
An in-depth investigation of a specific issue or theme in performance studies.

LCC 4602. Performance Practicum
3-0-3. Prerequisite(s): LCC 2600.
Practical experience and theoretical investigations in theater and performance including acting, directing, designing, playwriting, performance art, performance, and new media.

LCC 4904. Internship
Credit hours to be arranged.
Offers students a workplace-based learning experience that stresses application of principles and skills gained in other STC classes.

LCC 4906. Special Problems
Credit hours to be arranged.
Study of specialized aspects of literature or cultural studies selected on the basis of current interest.

LCC 6111. Graphics and Internet Design
3-0-3.
Introduction to graphic, hypertextual, and multimedia design with particular emphasis on the Internet.

LCC 6112. Video Production
3-0-3.
A theory/production course that combines the critical analysis of film and video with intensive practice in filming, linear editing, and digital video.

LCC 6113. Multimedia Design and Production
3-0-3.
The course introduces students to concepts and techniques essential to multimedia design and authoring.

LCC 6114. Advanced Design and Production
3-0-3. Prerequisite(s): LCC 6112 or LCC 6113.
A studio course dealing with advanced concepts and techniques of the design and production of digital media.

LCC 6115. Practicum in New Media
3-0-3. Prerequisite(s): LCC 6112 or LCC 6113.
A practical course in the development of new media productions.

LCC 6210. Studies in Communication and Culture
3-0-3.
Introduction to the discipline of communication studies that includes basic methods of cultural analysis as applied to various media forms.

LCC 6211. Digital Aesthetics
3-0-3.
Seminar on the nature and production of art and performance developed with new media and emerging technologies.

LCC 6212. Historical Approaches to New Media
3-0-3.
This seminar introduces students to the historical study of new media forms.

LCC 6213. Educational Applications of New Media
3-0-3.
This seminar introduces students to a variety of perspectives on learning as they apply to work in educational technology.

LCC 6214. New Media Project Design and Assessment
3-0-3.
This course presents structured methods for designing content units, interactivity paths, and media selection. Course exercises teach the basic process of iterative design and testing.

LCC 6215. Issues in Media Studies
3-0-3.
This course focuses on the study of mass media from historical, theoretical, and cultural perspectives.

LCC 6216. Globalization and New Media
3-0-3.
This course explores international aspects of new media forms, including the global situation of the development and use of new communication technologies.

LCC 6217. Visual Genealogy of New Media
3-0-3.
This course explores the relationship between new forms of digital media and earlier forms of technologies of visualization and representation.

LCC 6800. Master's Project: Information Design and Technology
3-0-3.
Final project course in information design and technology.

LCC 7000. Master's Thesis: Information Design and Technology
Credit hours to be arranged.
Final thesis course in information design and technology.

LCC 8801,-2,-3,-4,-5,-6. Special Topics in Information Design and Technology
Credit and class hours equal last digit of course number.

LCC 8910,-20,-30,-40,-50. Special Problems in Information Design and Technology
Credit hours to be arranged.
An independent study course.

LCC 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding teaching assistantships.

LCC 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding research assistantships.

Department of Military Science

Established in 1917
Location: Building 23 A, Bobby Dodd Way
Telephone: (404) 894-4760

Professor and Head–Lt. Col. Jerry G. Houston; *Assistant Professors*–Lt .Col. Lee Harford, Maj. Joseph Johnson, Maj. Charles Lewis, Capt. Andy Hemphill, Capt. Gregory Weisler.

General Information

The purpose of the Army ROTC is to prepare students for commissioning as officers in the Active Army, Army Reserve, or National Guard Forces. Concurrently, the overall program is designed to aid students in developing the abilities and attitudes that will make them academically successful and to develop well educated junior officers.

The curriculum is divided into two courses: a Basic Course open to all freshmen and sophomores, and an Advanced Course for qualified juniors, seniors, and graduate students. The student who is undecided about pursuing a commission has the option of participating in the Basic Course without incurring a military obligation. Successful completion of the Basic Course (or commensurate training), a minimum 2.0 cumulative grade point average, and the appropriate medical and physical qualifications are prerequisites for enrollment in the Advanced Course. Successful completion of both courses and the award of a bachelor's degree constitute the normal progression to gaining a commission as a second lieutenant. Courses are available to both men and women.

The overall Army ROTC curriculum prepares students to become effective leaders and managers in a variety of responsible and challenging commissioned officer fields, thus facilitating early middle-management career development and progression. A description of the course requirements and associated programs appears in the following paragraphs.

The Basic Course Curriculum

The basic program consists of a four-semester block of instruction taken during the freshman and sophomore years. Successful completion of all four semesters satisfies the military science requirements for progression to the Advanced Course. These courses provide a foundation in basic military subjects such as customs and traditions, history, leadership, and map reading. They round out a student's academic life, provide a challenge, foster confidence, and facilitate personal growth and development. Courses are offered fall and spring semesters with two credit hours awarded for each freshman and sophomore course and three credit hours for each junior and senior course. Six hours of basic ROTC courses may be applied as elective credits toward degree requirements at the school. Courses normally meet two hours a week. A one-hour leadership laboratory and participation in physical conditioning training are also required. Students in the Basic Course do not incur any military obligation unless they are on an ROTC scholarship. Scholarship cadets are required to participate in a field training exercise twice per school year. They are issued uniforms and may participate in other ROTC-related events and training, such as Airborne School, Air Assault School, and Northern Warfare Training. The Basic Course consists of the following:

FIRST YEAR

Course No. & Title		**Credit Hours**
MS 1021	Introduction to the Army	2
MS 1022	Introduction to Leadership	2

SECOND YEAR

Course No. & Title		**Credit Hours**
MS 2021	Self/Team Development	2
MS 2022	Individual/Team Military Tactics	2

Optional Basic Camp

Those academically qualified students who are unable to fulfill the requirements of the Basic Program during their freshman and sophomore years may qualify for admission to the Advanced Course by successfully completing basic camp preparatory training. This option is primarily designed to meet the needs of transfer students, those completing the sophomore year, and others, including graduate students, who have four semesters remaining at the Institute. This option provides a two-year program in lieu of the standard four-year curriculum.

The basic camp option consists of a five-week training period conducted at an active Army post during the summer months. During each summer, various cycles will be available to meet student needs. Students choosing this option are required to submit a formal application and pass a general physical.

Students electing the basic camp training program will receive approximately $700 in addition to travel expenses to and from the camp. Uniforms, housing, medical care, and meals are furnished by the government during the camp. Interested students should contact the Military Science Department.

The Advanced Course Curriculum

The Advanced Course is designed to fully develop a cadet's leadership and management potential, physical stamina, and self-confidence, as well as those personal characteristics desired in an Army officer. The objective is to produce the highest caliber junior officer fully capable of discharging a wide spectrum of command and management responsibilities in the modern Army and in the business world.

The Advanced Course consists of four semesters of instruction normally taken during the junior and senior years. Successful completion of the four courses fulfills the military science academic requirements for award of an officer's commission. Each student must also participate in a regular physical conditioning program and successfully pass the Army Physical Fitness Test. All Advanced Course students must participate in field training exercises twice a school year. Twelve credit hours are earned, nine of which may be applied as elective credits toward any degree at the Institute. Advanced Course students receive a subsistence allowance of $150 a month, not to exceed $1,500 per academic year. Service veterans and service academy cadets may qualify for direct entry into the Advanced Course. Certain Advanced Course students are eligible to participate in the Simultaneous Membership Program with the Army Reserve and National Guard. Students in this program affiliate with an Army unit as officer trainees.

Students enrolled in the Advanced Course are also required to complete a five-week advanced camp to become eligible for commissioning. Attendance at advanced camp normally occurs during the summer between the junior and senior years. Students may also participate in additional voluntary training, such as Airborne School or Cadet Troop Leader Training. In addition to completing the military science academic requirements of both the Basic and Advanced Courses, the student must complete at least one undergraduate course from each of five designated fields of study:

Written Communications: select any course offered by the institution in English composition or creative writing.

Human Behavior: select any course offered by the institution in psychology, sociology, anthropology, or ethics.

Military History/National Security Studies: select INTA 3520, INTA 3510, or other similar course approved by the professor of military science.

Computer Literacy: select any course offered by the College of Computing except CS 1000 (Information and Society).

Mathematics Reasoning: select any course offered by the School of Mathematics.

Students who successfully complete the Army ROTC curriculum and earn a bachelor's degree can be commissioned as second lieutenants. Subsequent military service may be on active duty or with the Army Reserve or National Guard. The following courses constitute the Advanced Course:

THIRD YEAR

Course No. & Title		Credit Hours
MS 3011	Leading Small Organizations I	3
MS 3012	Leading Small Organizations II	3

FOURTH YEAR

Course No. & Title		Credit Hours
MS 4011	Leadership Challenges and Goal Setting	3
MS 4012	Transition to Lieutenant	3

Scholarship Programs

Each year the Army offers a variety of full scholarship programs to those young men and women who have demonstrated outstanding academic scholarship and leadership potential. Four-, three-, and two-year scholarships are available to qualified students. Scholarships are competitive and awarded based on the student's merit. The Professor of Military Science receives an allocation of scholarships each year. Scholarships provide tuition to both resident and out-of-state students, a stipend for textbooks and supplies, and laboratory fees in addition to a $150-a-month tax-free allowance. Scholarship students serve either on active duty or in the reserves.

Options

Students who wish to obtain a commission as an officer but do not want to serve on active duty may request a guaranteed reserve forces duty scholarship. In this program, students are guaranteed in writing that they will not be placed on active duty and can fulfill their entire commitment in the Army Reserve or National Guard.

Student Advisory Services

Faculty members are available throughout the academic year and during each summer orientation session in the Department of Military Science for academic counseling, schedule planning, and career guidance. Students and their parents are encouraged to seek advice on the overall Army ROTC program, scholarship opportunities, and officer career development. Appointments may be made in person or by calling (404) 894-4760, or sending an e-mail message at the ROTC homepage: www.gatech.edu/armyrotc

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

MS 1021. Military Science I: Introduction to Army
2-0-2.
General introduction to the total Army structure, scope of the military officer profession, and general introduction to the primary weapon (M16A2) of the U.S. Army. Instruction on implementing an individual physical training program, customs and traditions, assembly and disassembly, maintenance, and the use of the M16A2 rifle. Individual/squad drill and ceremony are required.

MS 1022. Military Science I: Introduction to Leadership
2-0-2. Prerequisite(s): MS 1021
Learn/apply principles of effective leading. Reinforce self-confidence through participation in physically and mentally challenging exercises with upper-division ROTC students. Develop communication skills to improve individual performance and group interaction. Relate organizational ethical values to the effectiveness of a leader.

MS 2021. Military Science I: Self/Team Development
2-0-2. Prerequisite(s): MS 1022
Learn/apply ethics-based leadership skills that develop individual abilities and contribute to the building of effective teams of people. Develop skills in oral presentations, writing concisely, planning of events, coordination of group efforts, advanced first aid, land navigation, and basic military tactics.

MS 2022. Military Science II: Individual/Team Military Tactics
2-0-2. Prerequisite(s): MS 2021
Introduction to individual and team aspects of military tactics in small unit operations. Includes one of radio communications, making safety assessments, movement techniques, planning for team safety/security, and methods of pre-execution checks. Learn techniques for training others as an aspect of continued leadership development.

MS 3011. Military Science III: Leading Small Organizations I
3-0-3. Prerequisite(s): MS 2022
Series of practical opportunities to lead small groups, receive personal assessments and encouragement, and lead in situations of increasing complexity. Fundamentals of leadership and land navigation; two performance-oriented class periods and one laboratory period a week.

MS 3012. Military Science III: Leading Small Organizations II
3-0-3. Prerequisite(s): MS 3011
Small unit leadership and basic patrolling; two performance-oriented class periods and one laboratory period a week. Students analyze task; prepare written or oral guidance for team members to accomplish task. Delegate task and supervise. Plan for and adapt to the unexpected in organizations under stress. Examine and apply lessons from leadership case studies, examine importance of ethical decision making in setting a positive climate that enhances team performance.

MS 4014. Military Science IV: Challenges and Goal Setting
3-0-3. Prerequisite(s): MS 3012
Plan, conduct, and evaluate activities of the ROTC cadet organization. Articulate goals; put plans into action to attain them. Assess organizational cohesion and develop strategies to improve it. Develop confidence in skills to lead people and manage resources. Learn/apply various Army policies and programs in this effort.

MS 4015. Military Science V: Transition to Lieutenant
3-0-3. Prerequisite(s): MS 4014
Identify and resolve ethical dilemmas. Refine counseling and motivation techniques. Examine aspects of traditional law as it relates to leading, as an officer in the Army. Prepare for a future as a successful Army lieutenant.

Department of Modern Languages

Established in 1904
Location: Swann Building
Telephone: (404) 894-7327
Fax: (404) 894-0955
Website:
www.gatech.edu/iac/modlangs/Japanese/MLHome/index.html

Professor and Chair–Heidi M. Rockwood; *Professors*–Vicki B. Galloway, Angela Labarca, Edmun B. Richmond, Louis J. Zahn (emeritus); *Associate Professors*–Barbara L. Blackbourn, Jerry Carroll Brooks (emeritus), Bettina Cothran, William W. Johnson, Catherine C.F. Marin, Frank Pilipp, Rumiko Shinzato-Simonds, David J. Shook; *Assistant Professors*–Nora Cottille-Foley, Larry Joseph, Masato Kikuchi, Lionel Lemarchand, Xiaoliang Li; *Instructors*–Melissa Burns, Ilse Engler, Masako Kanno, Linlin Lu, Natalia Myshkin.

General Information

The diverse course offerings of the Department of Modern Languages provide students with opportunities for achieving reasonable fluency in understanding, speaking, reading, and writing several foreign languages. They also instruct students in the civilizations and literatures of the countries in which those languages are spoken.

Although the Department does not offer a degree or "major," certificates are available in French, German, Japanese, linguistics, and Spanish. To receive a certificate in one of these options, students must take 12 semester hours of courses on the 3000-level or above. In Japanese only, one three-hour course can be on the 2000 level. Students should consult the department for additional details.

Students may take any courses for which they have the prerequisites as specified in the catalog descriptions. Students who have had two years of a language in high school may not enroll for credit in the first 1000-level course in that language. Suggested entry level for students with two years of high school study is the second course of the 1000-level sequence. Those with three or more years are generally able to go into a 2000-level course in the more frequently taught languages. Usually, two years in high school equal one year at Tech. Counseling and placement examinations are available on request, especially in the less frequently taught languages. Each course is essentially a unit in itself, but beginning students are encouraged to pursue at least the elementary two-semester sequence in order to achieve a minimum level of proficiency and to receive humanities credit. Students may not enroll in or receive advanced standing for 1000-level courses after the successful completion of any 2000-, 3000-, or 4000-level course. Students who take courses in their native language must schedule courses no lower than 3001. Co-ops who are beginning a foreign language should limit themselves to French, German, Japanese, and Spanish courses.

Courses at the 2000-, 3000-, and 4000-level do not have to be taken in chronological order, provided prerequisites are fulfilled.

With minor exceptions, students can fulfill their humanities requirement for graduation by taking courses, including linguistics courses, in the Department of Modern Languages. Students should consult the catalog course descriptions and the section of this catalog titled "Humanities and Social Sciences Requirements," pages 33-34, in order to determine which courses are classified as humanities in their respective colleges. With the approval of their major schools, students may take any course offered by the Department of Modern Languages on a pass/fail basis.

College Credit for High School Study

The department will grant six hours of elective credit in French, German, Spanish, Chinese, Japanese, or Russian for high school study in a foreign language, provided the student has two or more years of high school credit in the language in question and has completed six semester hours at the 2000-, 3000-, or 4000-level with an average grade of *C* or higher. Transfer students must complete at least three of the six hours at Georgia Tech.

Students submitting a score of 4 or 5 on the College Entrance Examination Board Advanced Placement Examination in French, German, or Spanish "Language Level III" or "Literature Level III" may receive free elective credit for courses numbered 1001-2 in the respective language. Students who submit language scores of 5 or above from a certified high school international baccalaureate program may also receive free elective credit for courses numbered 1001-2 in the respective language.

The department will not grant credit for high school study in a foreign language to students who have taken 1000-level courses or the equivalent at Georgia Tech or at other college-level institutions for which they have received transfer credit.

To have the free elective credit entered on their records, students must request that the appropriate form be submitted by the Department of Modern Languages to the registrar. This elective credit is not applicable toward fulfillment of the humanities requirement for graduation. No grade is attached to this credit.

Doctoral Degree Language Requirements

See page 41.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

CHINESE

CHIN 1001. Elementary Chinese I
4-0-4.
Training in pronunciation, tones, and sentence structure to develop a baseline for listening, speaking, and reading Chinese, as well as fostering a sensitivity to Chinese culture.

CHIN 1002. Elementary Chinese II
4-0-4. Prerequisite(s): CHIN 1001.
Consolidating training in phonetics, grammar, sentence structure, and characters; focusing on the similarities and differences between English and Chinese.

CHIN 2001. Intermediate Chinese I
3-0-3. Prerequisite(s): CHIN 1002.
Reinforcing basic language skills and knowledge to enhance students' communication ability including oral dialogue and written correspondence in current Chinese society.

CHIN 2002. Intermediate Chinese II
3-0-3. Prerequisite(s): CHIN 2001.
Reinforcing basic language skills and knowledge to enhance students' communication ability including oral dialogue and written correspondence in current Chinese society.

CHIN 3001. Issues in Chinese Society and Culture I
3-0-3. Prerequisite(s): CHIN 2002.
Comprehension of and discussion about China's news, economic reports, political events, feature stories and sports on television and in newspapers.

CHIN 3002. Issues in Chinese Society and Culture II
3-0-3. Prerequisite(s): CHIN 3001.
Comprehension of and discussion about China's news, economic reports, political events, feature stories and sports on television and in newspapers.

CHIN 3801,-2. Special Topics in Chinese
3-0-3, each. Prerequisite(s): CHIN 3002.
Permits a group of students and a professor to pursue areas of the Chinese language not extensively treated in other courses of the department.

CHIN 4901,-2. Special Problems in Chinese
Credit hours to be arranged.
Provides special instruction according to special needs.

FRENCH

FREN 1001. Elementary French I
3-0-3.
An introduction to the French language and culture of the French-speaking world. Beginning of a survey of basic French grammar and the development of the four language skills of listening, speaking, reading, and writing French. Some aspects of everyday life in the French speaking world will also be introduced.

FREN 1002. Elementary French II
3-0-3. Prerequisite(s): FREN 1001.
The second part of an introduction to the French language and the culture of the French-speaking world. Completion of the survey of basic French grammar and further development of the four language skills. Aspects of everyday life in the French-speaking world will be introduced.

FREN 2001,-2. Patterns of French Culture I,-II
3-0-3, each. Prerequisite(s): FREN 1002.
Proficiency-based introduction to selected sociocultural aspects of France: geography, demography, social institutions, history, art, socioeconomic problems, and current events; incorporates grammar review. Conducted in French.

FREN 2021. Intermediate Conversation and Composition I
3-0-3. Prerequisite(s): FREN 1002.
A conversational approach to topics of current interest in the humanities in France with directed writing activities enhanced by both traditional and computer-assisted aids.

FREN 2022. Intermediate Conversation and Composition II
3-0-3. Prerequisite(s): FREN 1002.
A continuation of FREN 2021: Conversational approach to topics of current interest in the humanities in France with directed-writing activities enhanced by both traditional and computer-assisted aids.

FREN 3001. French Literature from 1800 to 1900
3-0-3. Prerequisite(s): FREN 2002.
Romanticism, the reappearance of lyric poetry, the importance of the individual as opposed to classical anonymity. Realism and naturalism with emphasis on the development of the novel. Conducted in French.

FREN 3002. French Literature from 1900 to Present
3-0-3. Prerequisite(s): FREN 2002.
Exploration of currents in modern prose, poetry, and drama. Conducted in French.

FREN 3004. Drama Workshop
3-0-3. Prerequisite(s): FREN 2001 or FREN 2002 or FREN 2021 or FREN 2022.
Literary and theatrical aspects of French drama are explored through class discussion and performance of selections from contemporary and classical plays.

FREN 3007. Survey of French Literature I
3-0-3. Prerequisite(s): FREN 2002.
Survey of French literature from the Middle Ages through the 17th century. Selected texts by representative authors. All readings and discussions are conducted in French.

FREN 3008. Survey of French Literature II
3-0-3. Prerequisite(s): FREN 2002.
Survey of French literature from the 18th century to present times. Selected texts by representative authors. All readings and discussions are conducted in French.

FREN 3011,-2. France Today I,-II
3-0-3, each. Prerequisite(s): FREN 2002.
Culture, history, and geography of modern France through lectures, videos, downloads from the Internet, audio and video tapes, and class discussions. Short papers generated by use of a computer software package treating assigned topics to enhance writing skills. Conducted in French.

FREN 3030. French Phonetics
3-0-3. Prerequisite(s): FREN 2002.
A detailed analysis of the significant features of the French sound system, intonation curves, and graphic representation of individual sounds. Conducted in French.

FREN 3061,-2. France: Culture, Economy, Commerce I, -II
3-0-3, each. Prerequisite(s): FREN 2002.
Advanced business French, overview of French commerce, communications, publicity, various social milieus, and the work place.

FREN 3121. Advanced Composition
3-0-3. Prerequisite(s): FREN 3002.
In-depth study of advanced grammar patterns as used in written expressions. Conducted in French.

FREN 3691. Business Communication and Correspondence in France
3-0-3. Prerequisite(s): FREN 1002; Co-requisites: FREN 3692 and FREN 3693.
Refinement of accuracy and flexibility in oral/written expression. Focus on appropriate use of strategies, business negotiation protocols, lexical precision. Incorporates grammar review. Part of the French intensive summer language program. See page 26. Admission by application only.

FREN 3692. French for Business and Technology I
3-0-3. Prerequisite(s): FREN 1002; Co-requisites: FREN 3691 and FREN 3693.
Study of business, technological, and cultural issues, tendencies and patterns of behavior among French-speaking people. Value systems and their manifestations. Part of the French intensive summer language program. See page 26. Admission by application only.

FREN 3693. French for Business and Technology II
3-0-3. Prerequisite(s): FREN 1002; Co-requisites: FREN 3691 and FREN 3692.
Business organizations and use of technology in France. Specialized vocabularies of economics, engineering, and computer science. Attention to geographical and anthropological aspects of selected social and political situations. Part of the French intensive summer language program. See page 26. Admission by application only.

FREN 3694. French for Business and Technology Abroad
3-0-3.
Two-week seminar in France highlighting business and technology. Field study of technology firms, economic trends, business institutions, and cultural protocols. Journals and papers assigned. Admission by application only.

FREN 3801,-2. Special Topics in French
3-0-3, each.
Permits a group of students and a professor to pursue areas of the French language not extensively treated in other courses in the Department.

FREN 4001. French Stylistics
3-0-3. Prerequisite(s): FREN 3121.
Advanced study of syntax and semantics, aimed at development of stylistic sensitivity. Analysis of representative literary and current interest texts for practice in conversation and composition. Conducted in French.

FREN 4061,-2. French Science and Technology I,-II
3-0-3, each. Prerequisite(s): FREN 3062.
Introduction to scientific and technical French. Analysis and discussion of scientific and technical material pertaining to current issues in the scientific and technical communities. Background in chemistry, physics, or biology required.

FREN 4101,-2. Literature of the Francophone World I, -II
3-0-3, each. Prerequisite(s): FREN 3001.
Exploration of the literature of the francophone world. Currents in modern prose, poetry, and drama. Conducted in French.

FREN 4901,-2. Special Problems in French
Credit hours to be arranged.
Provides the special instruction required under special programs.

GERMAN

GRMN 1001. Elementary German I
3-0-3.
An introduction to German language and culture. Beginning of a survey of basic German grammar and the development of the four language skills of listening, speaking, reading, and writing. Some aspects of everyday life in the German-speaking world will also be introduced.

GRMN 1002. Elementary German II
3-0-3. Prerequisite(s): GRMN 1001
The second part of an introduction to German language and culture. Survey of more basic German grammar and the development of the four language skills of listening, speaking, reading and writing. Some aspects of everyday life in the German-speaking world will also be introduced.

GRMN 2001,-2. Intermediate German I,-II
3-0-3, each. Prerequisite(s): GRMN 1002.
Review of basic grammatical concepts and vocabulary buildup. Selected readings, audio and video material on the cultural, historical, and intellectual development of Germany. Teaching and class discussion in German.

GRMN 3010. Introduction to German Literature
3-0-3. Prerequisite(s): GRMN 2002.
Introduction to the periods and genres of German literature from the Middle Ages to modern times. Conducted in German.

GRMN 3011. Germany Today
3-0-3. Prerequisite(s): GRMN 2002.
Introduction to current issues in contemporary Germany. Lectures, papers, and class discussions. Conducted in German.

GRMN 3024. Conversation and Composition
3-0-3. Prerequisite(s): GRMN 2001 or GRMN 2002.
A combination of conversation, composition, and stylistics, this course is designed to promote listening, speaking, and writing proficiency; expansion of vocabulary; stylistic skills.

GRMN 3025. Advanced Stylistics
3-0-3. Prerequisite(s): GRMN 2002.
Advanced study of syntax and semantics aimed at the development of stylistic sensitivity. Analysis of representative literary and current interest texts.

GRMN 3034. The German Novella
3-0-3. Prerequisite(s): GRMN 2002.
German novellas and short prose from 1800 to the present. Discussion of genre and social, political, and cultural background. All readings and discussions in German.

GRMN 3035. German Dramatic and Lyrical Literature
3-0-3. Prerequisite(s): GRMN 2002.
Introduction to dramatic and lyrical literature in interaction. Conducted in German.

GRMN 3036. German Novel
3-0-3. Prerequisite(s): GRMN 2002.
Readings and discussions from longer works of fiction from 1880 to present. Discussion of the genre, as well as the social, political, and cultural background. All readings and discussions in German.

GRMN 3071,-2. Introductory Business German I,-II
3-0-3, each. Prerequisite(s): GRMN 2002.
Analysis and discussion of texts and videos pertaining to issues in the current business world.

GRMN 3691. Business Communication and Correspondence in Germany
3-0-3. Prerequisite(s): GRMN 1002; Co-requisites: GRMN 3692 and GRMN 3693.
Refinement of accuracy and flexibility in oral/written expression. Focus on the appropriate language use in business situations, including telephone protocol, interviews, and negotiations. Incorporates grammar review and emphasis on cross-cultural comparison. Part of the intensive summer language program. Admission by application only.

GRMN 3692. German Business Culture
3-0-3. Prerequisite(s): GRMN 1002; Co-requisites: GRMN 3691 and GRMN 3693.
Study of German business structure and current issues. Business etiquette, comparative aspects of Germany and USA. Case studies on video. Part of the German intensive summer language program. Admission by application only.

GRMN 3693. German Science and Technology
3-0-3. Prerequisite(s): GRMN 1002; Co-requisites: GRMN 3691 and GRMN 3692.
Studies of firms and organizations in the energy and high-tech sector. Specialized vocabulary of engineering, computer science, alternative energy sources. Part of the German intensive summer language program. Admission by application only.

GRMN 3694. German Business and Technology Seminar Abroad
3-0-3. Prerequisite(s): GRMN 2001.
Two-week tour of German industry, government and technological institutions. Journals and papers assigned. Conducted in German. Admission by application only.

GRMN 4023. Selected Readings in German Literature
3-0-3. Prerequisite(s): GRMN 2002.
Study of selected authors, movements, genres, in German literature. Selection varies. Conducted in German.

GRMN 4024. German Film and Literature
3-0-3. Prerequisite(s): GRMN 2002.
A survey of German culture and recent past as presented through films and related literary works illuminating Germany's quest for identity since 1945.

GRMN 4061. Advanced Business German I
3-0-3. Prerequisite(s): GRMN 3072.
Advanced principles of German business organization and language. Taught through the use of reading, audio, and video materials. Conducted in German.

GRMN 4062. Advanced Business German II
3-0-3. Prerequisite(s): GRMN 4061.
Continuation of GRMN 4061.

GRMN 4901-2. Special Problems in German
Credit hours to be arranged.
Special problems course for advanced students. Topics to be arranged with instructor.

JAPANESE

JAPN 1001. Elementary Japanese I
4-0-4.
Essential principles of Japanese grammar and phonetics, acquisition of vocabulary through conversational exercises, video, and tape material. Introduction to the kana writing system.

JAPN 1002. Elementary Japanese II
4-0-4. Prerequisite(s): JAPN 1001.
Continuation of JAPN 1001. Introduction to kanji symbols.

JAPN 2001. Intermediate Japanese I
3-0-3. Prerequisite(s): JAPN 1002.
Further principles of Japanese grammar and vocabulary. Introduction to different styles and levels of speech. More kanji.

JAPN 2002. Intermediate Japanese II
3-0-3. Prerequisite(s): JAPN 2001.
Continuation of JAPN 2001.

JAPN 3001. Advanced Japanese I
3-0-3. Prerequisite(s): JAPN 2002.
Learn advanced grammar structures and develop the ability to produce longer conversations involving complex styles and levels of speech. More kanji.

JAPN 3002. Advanced Japanese II
3-0-3. Prerequisite(s): JAPN 3001.
Continuation of JAPN 3001.

JAPN 3061. Technical Japanese I
3-0-3. Prerequisite(s): JAPN 2002.
Introduction to technical and scientific Japanese. Specialized vocabulary and concepts of chemistry, electrical engineering, computer science, and biology. Analysis and discussion of scientific issues in society.

JAPN 3062. Technical Japanese II
3-0-3. Prerequisite(s): JAPN 3061.
Continuation of technical and scientific Japanese. Specialized vocabulary and concepts of chemistry, electrical engineering, computer science, and biology. Analysis and discussion of scientific issues in society.

JAPN 3691. Technical and Scientific Japanese
3-0-3. Prerequisite(s): JAPN 1002; Co-requisites: JAPN 3692 and JAPN 3693.
Reading of intermediate/advanced technical and scientific Japanese texts. Analysis and discussion of scientific issues in society. Part of the Japanese intensive summer language program. Admission by application only.

JAPN 3692. Business Japanese
3-0-3. Prerequisite(s): JAPN 1002; Co-requisites: JAPN 3691 and JAPN 3693.
Acquisition of business terminology, protocols, decorum strategies and improvement of oral communication skills. Reading and writing of notes, correspondence, and reports. Part of the Japanese intensive summer language program. Admission by application only.

JAPN 3693. Japan Today
3-0-3. Prerequisite(s): JAPN 1002; Co-requisites: JAPN 3691 and JAPN 3692.
Development of awareness toward cultural differences and potential communication problems through exploration of current socio-economic and corporate-cultural issues in Japan. Part of the Japanese intensive summer language program. Admission by application only.

JAPN 4801,-2. Special Topics in Japanese
3-0-3, each.
Provides specific instruction in Japanese. Individual syllabus will be filed with the Department.

LINGUISTICS

LING 2001. Introduction to Language I
3-0-3.
Introduction to basic concepts of language analysis: morphology and phonology. Linguistics in relation to other sciences.

LING 2002. Introduction to Language II
3-0-3. Prerequisite(s): LING 2001.
Introduction to modern syntactic and semantic theories of language, as well as to the relationship between language, culture, and society.

LING 3006. Black English
3-0-3. Prerequisite(s): LING 2001 or LING 2002.
Origins and development of American Black English from the 1600s to the present. Includes analysis of its structure and its relationship to African languages and cultures.

LING 3010. Language Evolution
3-0-3. Prerequisite(s): LING 2001 or LING 2002.
Principles of historical evolution of language, illustrated primarily through examples from Indo-European languages.

LING 3750. International Language Policies
3-0-3. Prerequisite(s): INTA 1110.
An introduction to the politics, problems, and alternative solutions in national language choices, including a competitive analysis of industrialized and developing nations.

LING 3801,-2,-3. Special Topics in Modern Languages
3-0-3, each.
Permits students to work in languages not treated in other courses and/or to engage in special language research.

LING 4002. Current Trends in Linguistic Theory
3-0-3. Prerequisite(s): LING 2001 or LING 2002.
Introduction to developments in contemporary linguistic theory, especially in syntax and semantics.

LING 4901,-2. Special Problems in Linguistics
Credit hours to be arranged.
Special problems course for advanced students; topics to be arranged with instructor.

RUSSIAN

RUSS 1001. Elementary Russian I
3-0-3.
An introduction to Russian language and culture. First half of a survey of basic Russian grammar and the development of the four language skills of listening, speaking, reading, and writing. The course includes an orientation to aspects of everyday life in Russia.

RUSS 1002. Elementary Russian II
3-0-3. Prerequisite(s): RUSS 1001.
Second half of an introduction to Russian language and culture. Second half of a survey of basic Russian grammar and the development of the four basic language skills of listening, speaking, reading, and writing. The course includes an orientation to aspects of everyday life in Russia.

RUSS 2001. Intermediate Russian I
3-0-3. Prerequisite(s): RUSS 1002.
A review and extension of basic grammar with intensive vocabulary-building and focus on development of idiom on the basis of conversation, reading, and writing activities. Includes reading and discussion of stories and magazine articles of general cultural interest with follow-up composition assignments.

RUSS 2002. Intermediate Russian II
3-0-3. Prerequisite(s): RUSS 2001.
A review and extension of basic grammar with intensive vocabulary-building and focus on development of idiom on the basics of conversation, reading, and writing activities. Includes reading and discussion of stories and magazine articles of general cultural interest with follow-up composition assignments.

RUSS 3801,-2. Special Topics in Russian
3-0-3, each.
Permits a group of students and a professor to pursue areas of the Russian language not extensively treated in other courses in the department.

RUSS 4901,-2. Special Problems in Russian
Credit hours to be arranged.
Provides the special instruction required under special programs.

SPANISH

SPAN 1001. Elementary Spanish I
3-0-3.
An introduction to the Spanish language and the cultures of the Spanish-speaking world. Beginning of a survey of basic Spanish grammar and the development of the four language skills of listening, speaking, reading, and writing. Some aspects of everyday life in the Spanish-speaking world will also be introduced. Conducted in Spanish.

SPAN 1002. Elementary Spanish II
3-0-3. Prerequisite(s): SPAN 1001.
The second part of an introduction to the Spanish language and cultures of the Spanish-speaking world. Completion of the survey of basic Spanish grammar and the development of the four language skills of listening, speaking, reading, and writing. Aspects of everyday life in the Spanish-speaking world will also be introduced. Conducted in Spanish.

SPAN 2001,-2. Intermediate Spanish I,-II
3-0-3, each. Prerequisite(s): SPAN 1002.
Review of basic grammatical concepts: conversational, reading, and writing activities; cultural aspects of the Hispanic world. Conducted in Spanish.

SPAN 3061. Spanish for Business I: Fundamentals
3-0-3. Prerequisite(s): SPAN 2002.
Introduction to business language in the Hispanic world. Development of linguistic abilities to this end, with emphasis on those cultural factors that lead to commercial success. Conducted in Spanish.

SPAN 3062. Spanish for Business II: Applications
3-0-3. Prerequisite(s): SPAN 3061
Focus on the oral and written language and cultural context of Hispanic business protocols; themes and situations include banking and finance, marketing and advertising structures and practices. Conducted in Spanish.

SPAN 3101,-2. Spanish Conversation: Issues and Strategies I,-II
3-0-3, each. Prerequisite(s): SPAN 2002.
Development of communicative ability and cross-cultural awareness through discussion of contemporary issues in the Hispanic world.

SPAN 3111,-2. Composition: Analysis and Development I,-II
3-0-3, each. Prerequisite(s): SPAN 2002.
Writings from the Hispanic world used as a springboard for analysis and enrichment of self-expression and development of precision in written communication. Incorporates grammar review.

SPAN 3121. The Cultural History of Spain I: Prehistory to Renaissance
3-0-3. Prerequisite(s): SPAN 2002.
History of Spanish culture from prehistoric times to 1700. Conducted in Spanish.

SPAN 3122. Cultural History of Spain II: 19th and 20th Century Spain
3-0-3. Prerequisite(s): SPAN 2002.
History of Spanish culture from 1700 to the present. Conducted in Spanish.

SPAN 3170. Spanish Phonetics and Phonology
3-0-3. Prerequisite(s): SPAN 2002.
Study of the phonological system of the Spanish language, including dialectal variations in the Hispanic world.

SPAN 3235. Latin America Today
3-0-3. Prerequisite(s): SPAN 2002.
Selected journalistic and literary writings used as a springboard for discussion of social, economic, and political issues of contemporary Latin America. Conducted in Spanish.

SPAN 3236. Business Communication and Correspondence
3-0-3. Prerequisite(s): SPAN 3062.
Development of culturally appropriate written and oral interaction skills in Hispanic business contexts. Conducted in Spanish.

SPAN 3241. The Individual and the Family in Hispanic Literature
3-0-3. Prerequisite(s): SPAN 2002
Analysis and discussion of the portrayal of the individual and the family in selected readings from Hispanic literature. Conducted in Spanish.

SPAN 3242. Society in Hispanic Literature
3-0-3. Prerequisite(s): SPAN 2002.
Study of Hispanic society and political thought in selected literary works. Conducted in Spanish.

SPAN 3691. Business Communication and Correspondence in the Hispanic World
3-0-3. Prerequisite(s): SPAN 1002; Co-requisites: SPAN 3692 and SPAN 3693.
Refinement of accuracy/flexibility in oral/written expression. Focus on appropriate use of strategies, business negotiation protocols, lexical precision in business transactions. Incorporates grammar review. Part of the Spanish intensive summer language program. Admission by application only.

SPAN 3692. Business and Culture in the Hispanic World
3-0-3. Prerequisite(s): SPAN 1002; Co-requisites: SPAN 3691 and SPAN 3693.
Study of cultural issues, tendencies, and traditional patterns of behavior in Spanish-speaking people, as they relate to business practices. Value systems and formal manifestations. Regional variations, including the U.S. Hispanic culture. Part of the Spanish intensive summer language program. Admission by application only.

SPAN 3693. Science and Technology in the Hispanic World
3-0-3. Prerequisite(s): SPAN 1002; Co-requisites: SPAN 3691 and SPAN 3692.
Study of business organizations and use of technology in the Spanish-speaking world. Specialized vocabularies of business, economics, statistics, and computer science. Geographical and anthropological background. Part of the Spanish intensive summer language program. Admission by application only.

SPAN 3694. Business and Culture in the Hispanic World: Seminar Abroad
3-0-3.
Field study of technology, economic trends, business firms, financial institutions, and cultural protocols in the Spanish-speaking area. Part of the Spanish intensive summer language program. Admission by application only.

SPAN 4061. Spanish for Science and Technology I: Fundamentals
3-0-3. Prerequisite(s): SPAN 3062.
Introduction to scientific vocabulary and discourse in Spanish, by fields of interest. Study of expository texts, numerical expressions, and graphic aids. Development of some reading and translation strategies. Writing feature descriptions and article/report summaries in Spanish. Conducted in Spanish.

SPAN 4062. Spanish for Science and Technology II: Applications
3-0-3. Prerequisite(s): SPAN 3062.
Advanced analysis of scientific and technological discourse in Spanish. Focus on reading strategies and oral discussion of topics such as use and transfer of technology and the acculturation issues that follow. Further development of comprehension, production, and translation strategies, with emphasis on professional communications and on writing feature descriptions, summaries, and abstracts. Conducted in Spanish.

SPAN 4141. Survey of Spanish Literature
3-0-3. Prerequisite(s): SPAN 3102.
Selected works by representative authors from all periods of Spanish literature. Conducted in Spanish.

SPAN 4142. Survey of Latin-American Literature
3-0-3. Prerequisite(s): SPAN 3102.
Selected works by representative authors from all periods of Latin American literature. Conducted in Spanish.

SPAN 4151. Hispanic Fiction: The Short Story in Spain
3-0-3. Prerequisite(s): SPAN 3102.
The short story in the literature of Spain from the Middle Ages to the present. Conducted in Spanish.

SPAN 4152. Hispanic Fiction: The Latin-American Short Story
3-0-3. Prerequisite(s): SPAN 3102.
The short story in the literatures of Latin America, from independence to the present. Conducted in Spanish.

SPAN 4154. Hispanic Fiction: The Modern Drama
3-0-3. Prerequisite(s): SPAN 3102.
Works by representative Hispanic dramatists of the 20th century. Conducted in Spanish.

SPAN 4170. Spanish Applied Linguistics
3-0-3. Prerequisite(s): SPAN 3111.
Advanced linguistic analysis of the Spanish language, particularly as it contrasts with English.

SPAN 4255. Hispanic Drama Workshop
3-0-3. Prerequisite(s): SPAN 3102.
Literary and theatrical aspects of Hispanic drama are explored through class discussion and performance of a collection of contemporary one-act plays.

SPAN 4901,-2. Special Problems in Spanish
Credit hours to be arranged.
Provides the special instruction required under special programs.

Department of Naval Sciences

Established in 1926
Location: Naval Armory, Bobby Dodd Way
Telephone: (404) 894-4771/4772
Fax: (404) 894-6029
Website: www.cyberbuzz.gatech.edu
E-mail: nsfacej@prism.gatech.edu

Commanding Officer and Professor–Capt. Ralph H. Coon Jr., USN; *Executive Officer*– Cdr. Edward J. Johnson, USN; *Faculty*–Lt. Keith Hansen, USN; Capt. Aaron Potter, USMC, Lt. Glen Sabin, USN; Lt. Thomas Dixon, USN.

General Information

The NROTC program offers students the opportunity to qualify for service as commissioned officers in the United States Navy or Marine Corps. The program's objectives are to provide students with an understanding of the basic concepts and principles of naval science, associated professional knowledge, and the requirements for national security. NROTC students receive an educational background that allows them to later undertake advanced education in the naval service. The NROTC program is an officer ascension program for the unrestricted line communities. Upon graduation, the student is commissioned as an officer in the Naval Reserve or Marine Corps Reserve. Naval officers are ordered to active duty in submarines, surface combatants, or the aviation community. Marines undergo training leading to a variety of specialties. NROTC students are enrolled in one of the three categories outlined below.

Scholarship Students

Four-year and three-year scholarship students are selected through nationwide competition. Selection criteria include SAT or ACT scores, high school academic performance, and extracurricular activities. The selection process is administered by the Naval Recruiting Command; however, the NROTC unit will provide guidance and information to applicants. The NROTC scholarship pays for tuition, fees, and textbooks. The Navy also provides uniforms and a $150 per month subsistence allowance. The Naval Science Department conducts an orientation program (INFORM) for all new NROTC scholarship students during the week prior to the start of the fall semester. Scholarship students must complete the naval science curriculum and also participate in cruises from four-to-six weeks duration during the summers between academic years.

College Program Students

Nonscholarship students may seek a naval commission through the NROTC College Program. Interested students may apply at the Naval Armory on campus. The process includes a review of previous academic performance and interviews with staff personnel. Students accepted into the College Program must complete the Naval Science curriculum and take a cruise between junior and senior years. The Navy provides uniforms and Naval Science texts. Students who enter advanced standing in the junior year receive a subsistence allowance of $150 per month. College program students are eligible to compete for scholarships ranging from one-to-three years. Selection criteria are based on academic performance at Georgia Tech and military performance as a College Program student. For information, contact the Naval Science Department at (404) 894-4771.

Two-Year Scholarship Program

Sophomores may apply and compete nationally for two-year NROTC scholarships. Those selected attend six weeks of training in Newport, Rhode Island, during the summer between the sophomore and junior years. Upon successful completion, the student joins the NROTC program on an equal footing with other students in the junior year naval science classes. Interested students should contact the Naval Science Department.

Curriculum

In addition to the required naval science courses, all Navy Option Scholarship Students must take calculus (MATH 1501-2 or MATH 1511-2), physics (PHYS 2111-2 or 2231-3 series), or one semester of INTA (contact NROTC unit for required class) and one term of computer science.

Marine Option students must also take the above listed international affairs courses or their equivalent as approved by the professor of Naval Science. Any additional requirements are based on whether the student is in a technical or nontechnical major, a Navy Option or Marine Option student, and a scholarship or nonscholarship recipient. Each student must obtain from the NROTC Department a complete description of program requirements since the above statement is only a general outline. No more than six hours of credit in basic naval science courses and no more than nine hours of credit in advanced naval science courses will be applied toward degree requirements.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

NS 1321. Introduction to Naval Sciences
3-0-3.
This course is an introduction and orientation class designed to give students a broad overview of the roles of the U.S. Navy and Marine Corps. This course also provides an introduction to the structure, terminology, customs, and uniforms of the Navy and Marine Corps.

NS 1323. Naval Maritime History
3-0-3. Prerequisite(s): NS 1321.
This course surveys U.S. Naval history from its European origin to the present with emphasis on major developments and the geopolitical forces shaping these developments. The course also covers present day concerns in seapower and maritime affairs, including the economic and political issues of maritime commerce, the law of the sea, and the rise and decline of the Soviet Navy.

NS 2321. Naval Leadership and Management
3-0-3. Prerequisite(s): NS 1321.
Survey of managerial functions, communication, and major theories of leadership and motivation applied to the Navy organization. Culminates with focus on Naval core values.

NS 2322. Naval Systems Engineering I
3-0-3. Prerequisite(s): NS 1321.
This course develops and broadens the student's understanding of basic engineering concepts and principles as applied to naval engineering plants.

NS 3321. Navigation I
3-0-3. Prerequisite(s): NS 2321.
This course develops and broadens the student's understanding of basic piloting and the laws of vessel operations by applying the fundamentals of navigation at sea.

NS 3322. Navigation II
3-0-3. Prerequisite(s): NS 3321.
This course develops and broadens the student's understanding of relative motion, surface ship operations, and naval command, control, and communications.

NS 3323. Evolution of Warfare
3-0-3. Prerequisite(s): NS 1321
A historical exploration of warfare practiced by great nations. Selected campaigns are studied with emphasis on leadership, evolution of tactics, weaponry, and principles of war

NS 4321. Naval Engineering II
3-0-3. Prerequisite(s): NS 2322.
This course develops and broadens the student's understanding of basic engineering concepts and principles as applied to naval weapon systems.

NS 4322. Naval Leadership and Ethics
3-0-3. Prerequisite(s): NS 2321.
Study of Naval values and ethics to include core values, Navy regulations, and military law. Duties and responsibilities of a junior naval officer.

NS 4323. Amphibious Warfare
3-0-3. Prerequisite(s): NS 1321.
A historical exploration of warfare practiced by great nations. Selected campaigns are studied with emphasis on leadership, evolution of tactics, and principles of war.

Philosophy, Science, and Technology

Established in 1990
Location: D.M. Smith Building, Room 107
685 Cherry Street
Telephone: (404) 894-6822
Fax: (404) 894-0535
E-mail: deborah.johnson@pubpolicy.gatech.edu

Director and Professor–Deborah G. Johnson; *Professors*–Nancy J. Nersessian, Bryan G. Norton; *Assistant Professors*–Molly Cochran, Hans Klein, Jon J. Johnston, Juan Rogers.

General Information

Georgia Tech offers undergraduate courses in philosophy, with a particular focus on science and technology. The courses are intended to broaden the students' perception of the world around them and to focus their understanding of the context of their lives as professionals and citizens. Philosophy courses can be used to satisfy the distribution requirement in humanities.

A certificate program in philosophy is available for students who wish to concentrate course work in this field. The certificate program consists of 15 hours of course work, chosen in consultation with the director.

Students should consult the director or others in the philosophy faculty concerning the schedule of course offerings.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

PHILOSOPHY, SCIENCE, AND TECHNOLOGY

PST 1101. Introduction to Philosophical Analysis
3-0-3.
An introduction to the nature of philosophy through the critical analysis of selected works, such as Descartes, Hobbes, and Locke. The relationship of philosophy to science, religion, and culture will be emphasized.

PST 2050. Philosophy and Political Theory
3-0-3.
Survey of political thought from ancient times, relating classical and modern political theories to problems of the modern democratic state. Special emphasis on the problems of the individual and state.

PST 2068. Science and Values in the Policy Process
3-0-3.
Normative and logical structures of policy analysis, with applications of moral theories and deductive reasoning to cases in policy analysis. Frameworks include utilitarianism, benefit/cost analysis, and rights theories.

PST 3102. Ancient Philosophy
3-0-3.
Development of philosophy from the pre-Socratics to the medieval Christian synthesis and the early development of science in the 14th and 15th centuries.

PST 3103. Modern Philosophy
3-0-3.
A study of the development of philosophy from the views of Bacon and Descartes to the Tractatus and to existential thought. Traces the philosophic response to modern science in the rational and empirical traditions.

PST 3105. Ethical Theories
3-0-3.
Surveys traditional ethical theories of value, obligation, and rights and applies these theories to contemporary social problems such as abortion, euthanasia, poverty and distributional equity, and environmental problems.

PST 3109. Ethics and Technical Professions
3-0-3. Prerequisite(s): ENGL 1102.
Ethical reasoning in the context of professional work in science and technology. Prepares future technical professionals to approach decisions with a coherent ethical framework.

PST 3113. Logic and Critical Thinking
3-0-3.
Symbolic logic and applications of logic in critical reading and thinking by exploring modern systems of symbolic logic and their implications for science. Emphasizes skills in critical thinking and writing based on the principles of logic.

PST 3115. Philosophy of Science
3-0-3.
Examination of the nature and processes of scientific inquiry, including the status of scientific knowledge, identification of pseudoscientific claims, and the role of values in generating and using scientific knowledge.

PST 3127. Science, Technology, and Human Values
3-0-3.
Exploration of the boundaries between science, religion, and social values, examining science and technology in a broader social context. Examines claims that science is isolated from social problems and values.

PST 3790. Introduction to Cognitive Science
3-0-3.
Multidisciplinary perspectives on cognitive science. Interdisciplinary approaches to issues in cognition, including memory, language, problem solving, learning, perception, and action. Crosslisted with CS, PSYC, and ISYE 3790.

PST 4110. Theories of Knowledge
3-0-3.
Critical examination of perception, verification, apriori and aposteriori knowledge, meaning and criteria of truth, and cognitive significance of scientific and philosophical propositions. Evolution of epistemology.

PST 4112. Philosophic Themes in Asian Thought
3-0-3.
Survey of selected metaphysical and ethical ideas in the religious and philosophic traditions of east Asia, including Hindu conceptions of the self and causality, Buddhism and Zen, and the ethical naturalism of Confucianism and Taoism.

PST 4174. Perspectives in Science and Technology
3-0-3.
Comparative analysis of frameworks for interpreting science and technology, discussed in light of case studies. Selected frameworks include philosophical, historical, cognitive, and sociological.

PST 4176. Environmental Ethics
3-0-3.
Conceptual and normative foundations of environmental attitudes and values. Impacts of traditional and modern beliefs that shape human attitudes toward nature on creating a more compatible relationship between humans and their environment.

PST 4752. Philosophical Issues in Computation
3-0-3. Prerequisite(s): PST 3115.
Introduction to metaphysical and epistemological issues in foundations, methods, and implications of computing. Issues include: minds, brains, and machines; representation and language; simulating nature. Crosslisted with CS 4752.

PST 4790. Seminar in Cognitive Science
3-0-3.
A seminar-type course in cognitive science focusing on integrating and deepening students' cognitive science knowledge and skills. Topics include memory, language, problem solving, learning, perception, and action. Crosslisted with CS, PSYC, and ISYE 4790.

PST 4791. Integrative Project in Cognitive Science
3-0-3.
An integrative course in cognitive science focusing on the integration and use of concepts and skills from cognitive science. A different integrative project or set of projects will be taken in each semester; students will contribute on the basis of their background and skills. Crosslisted with CS, ISYE, and PSYC 4791.

PST 4792. Design Project in Cognitive Science
3-0-3.
Individual project with a cognitive science faculty member, designed as a supplement to the student's senior design project or thesis in their major area. Crosslisted with CS, ISYE, and PSYC 4792.

PST 4801,-2,-3. Special Topics
3-0-3, each.

PST 4901,-2,-3. Special Problems
Credit hours to be arranged.

Political Science

Established in 1990
Location: D.M. Smith Building, Room 107
685 Cherry Street
Telephone: (404) 894-6822

Professors–Barry Bozeman, Linda P. Brady, John E. Endicott, John W. Garver, Robert Kennedy, William J. Long, John R. McIntyre, Daniel Papp, Georgia Persons, J. David Roessner, Michael D. Salamone; *Associate Professors*–Richard P. Barke, John Havick, Brian Woodall; *Assistant Professors*–Kirk Bowman, Peter Brecke, William R. Clark, Molly Cochran, Jesus Felipe, Mark Hallerberg, Gordon Kingsley, Hans Klein, Adam Stulberg, Fei-Ling Wang, Katja Weber.

General Information

The discipline of political science is included within the Ivan Allen College within the School of Public Policy and the Sam Nunn School of International Affairs. Undergraduate courses in political science are intended to broaden the students' perceptions of political processes and governmental institutions. Many of these courses are taught under the PUBP or INTA prefix. Students should consult with the political science faculty concerning course offerings.

Political science courses may be used to satisfy the distribution requirement in social sciences, including the state-mandated requirement on constitutions of the United States and Georgia. This requirement may be satisfied by completion of POL 1101 or PUBP 3000, or INTA 1200, or HIST 2111 or 2112. The requirement also may be satisfied by examination.

Certificate and minor programs in political science, administered by the School of Public Policy, are available for students who wish to concentrate course work in this discipline. The certificate in political science requires 12 hours of course work, chosen in consultation with the faculty. The minor in political science requires 18 hours of course work (at least 12 hours at the 3000-level or higher), also chosen with the advice of the faculty coordinator.

POLITICAL SCIENCE

POL 1101. Government of the United States
3-0-3.
The purposes, structure, and functions of national and state governments, focusing on participation, institutions, and the policy process. Foundations of law, civil rights and civil liberties, role of the media, parties and elections, and policy processes.

POL 2101. State and Local Government
3-0-3.
Politics and government processes at the state and local levels.

School of Public Policy

Established in 1990
Location: D.M. Smith Building, Rm. 107
685 Cherry Street
Telephone: (404) 894-6822
Fax: (404) 894-0504
Website: www.gatech.edu/spp

Chair and Professor–Susan E. Cozzens; *Professors*–Barry Bozeman, Deborah G. Johnson, Nancy Nersessian, Bryan G. Norton, Georgia Persons, J. David Roessner; *Associate Professors*–Richard P. Barke, Ann Bostrom, John Havick, Philip Shapira, William Watson; *Assistant Professors*–Michael Farmer, Gordon Kingsley, Hans Klein, Jon J. Johnston, Juan Rogers; *Joint Professors*–Michael Elliott, Arthur C. Nelson, Alan Porter, Michael Rodgers, David Sawicki.

General Information

Who will own the Internet, and under what rules? Which new reproductive technologies will be developed and which declared illegal? How do we balance economic growth and the needs of ecological systems? Questions like these are answered through complex, collective decision-making processes, involving business, government, and the public. Public policy is the process of defining, debating, and deciding the issues. With a Georgia Tech public policy degree, students are prepared for leadership in business, law, or government. As all those areas become increasingly technology dependent, the unique skills and knowledge gained by a policy degree become more valuable.

The School of Public Policy offers B.S., M.S., and Ph.D. degrees in Public Policy, as well as undergraduate course work in several social science disciplines whose theories and methods contribute to the systematic study of public policy problems. The School shares responsibilities for offering undergraduate courses in political science, philosophy, and other social sciences with the other units in the Ivan Allen College. Undergraduates interested in public policy will also find relevant courses offered by the City Planning Program in the College of Architecture.

Certificates

The School of Public Policy offers four undergraduate certificates.

- **The Public Policy certificate** features courses on government and business decision processes, especially those involving science, technology, environment, or regional development.
- **The Pre-Law certificate** prepares students for decisions about law school through a pre-law seminar and courses on constitutional and judicial processes, plus selected courses in computer science, economics, history, and international affairs.
- **The Political Science certificate** focuses on how government works, from the local to the national level.
- **The Philosophy, Science, and Technology certificate** provides broad perspectives and critical thinking about science and technology, emphasizing values and ethics.

The certificates enrich any Georgia Tech degree, and particularly serve students who are planning graduate studies in law, medicine, business, or the social sciences. All of these certificates require a minimum of 12 semester hours of concentration. Students interested in planning a certificate program in one of the four areas should contact the School of Public Policy for further information. A faculty advisor assists each student in planning a program of study to meet his or her needs and interests.

Minor Programs

The School offers minors in Public Policy; Political Science; and Philosophy, Science, and Technology for students wishing a concentration outside of their major that provides greater depth than the certificate programs. Each minor requires a minimum of 18 hours of credit (12 semester hours at the 3000 level or higher) with a grade of *C* or better in each. Completion of a minor will be recognized on the student's final university transcript.

Undergraduate Program

Bachelor of Science

The Bachelor of Science in Public Policy (B.S.P.P.) is designed to provide an education that combines strong analytical skills with understanding of a range of substantive policy issues and the political and sociocultural forces that shape public policies. The B.S.P.P. core courses provide students with the broad political and philosophical foundations of thought pertinent to public policy, the basis of rigorous quantitative and qualitative analytical approaches, and a solid understanding of the political, social, and cultural dynamics that structure policy debates and policy outcomes. The core courses combine with a set of electives to permit students to follow individual tracks of specialization such as environmental policy, science and technology policy, information policy, and urban and regional development policy. Of particular note is the opportunity for students to choose courses that emphasize the development of an analytical-skills specialty, which will constitute a strong and unique comparative advantage for B.S.P.P. graduates.

Bachelor of Science in Public Policy (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501 or MATH 1712		4
LAB SCIENCE	(CHEM, BIOL, PHYS, EAS)	4
POL 1101	GOVERNMENT OF THE U.S.	3
TOTAL SEMESTER HOURS		14

First Year - Spring Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502 or MATH 1711		4
LAB SCIENCE (CHEM, BIOL, PHYS, EAS)		4
CS 1301	COMPUTER SCIENCE	3
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS		16

Second Year - Fall Semester

Course Number/Name		*Hours*
PST 2050	PHILOSOPHY & POLITICAL THEORY	3
PUBP 2012	FOUNDATIONS OF PUBLIC POLICY	3
LAB SCIENCE (CHEM, BIOL, PHYS, EAS)		4
HIST 2111 or 2112		3
ECON 2105	MACROECONOMICS	3
TOTAL SEMESTER HOURS		16

Second Year - Spring Semester

Course Number/Name		*Hours*
PUBP 2014	LEGISLATIVE PROCESS	3
PST 2068	SCIENCE & VALUES	3
LAB SCIENCE (CHEM, BIOL, PHYS, EAS)		4
HIST ELECTIVE		3
ECON 2106	MICROECONOMICS	3
TOTAL SEMESTER HOURS		16

Third Year - Fall Semester

Course Number/Name		*Hours*
PUBP 3201	INTRO. TO SOCIAL POLICY	3
PUBP 3113	STATISTICAL ANALYSIS	3
PST/PUBP 3XXX OR 4XXX		3
FREE ELECTIVE		6
TOTAL SEMESTER HOURS		15

Third Year - Spring Semester

Course Number/Name		*Hours*
PUBP 3110	RESEARCH METHODS	3
PUBP 3XXX	ELECTIVE	3
PUBP 3600	SUSTAINABILITY, TECH., & POLICY	3
FREE ELECTIVE		6
TOTAL SEMESTER HOURS		15

Fourth Year - Fall Semester

Course Number/Name		*Hours*
PUBP 3XXX OR 4XXX ELECTIVE		9
FREE ELECTIVE		6
TOTAL SEMESTER HOURS		15

Fourth Year - Spring Semester

Course Number/Name		*Hours*
PUBP 4600	SENIOR SEMINAR/THESIS	3
PUBP 3XXX or 4XXX ELECTIVE		6
PST/PUBP 3XXX or 4XXX		6
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HRS)

Requirements and Electives

Designated Courses in the Major

The core curriculum for the major consists of:

POL 1101	Government of the U.S.
PUBP 2012	Foundations of Public Policy
PST 2050	Philosophy and Political Theory
PST 2068	Science and Values in the Policy Process
PUBP 3010	Bureaucracy and Policy Implementation
PUBP 3110	Research Methods and Problem Solving
PUBP 3113	Statistical Analysis for Public Policy
PUBP 3201	Introduction to Social Policy
PUBP 3600	Sustainability, Technology and Policy
PUBP 4600	Senior Seminar/Thesis

Elective Courses in the Major

Students must take an additional 15 hours of courses in public policy as electives, usually focusing on a concentration in a substantive area of public policy or in policy analytic methods. These courses will be selected from an approved list, including courses with PUBP, POL, and PST prefixes, in consultation with an advisor.

Mathematics
Previous course work in calculus is assumed in the core statistics course for majors as well as in economics courses in public policy. To prepare, students are advised to fulfill the mathematics requirement by taking MATH 1507-8. MATH 1711-12, or MATH 1711 with either 1507 or 1508, will also satisfy the requirement. Students cannot receive credit for both MATH 1712 and MATH 1507 or 1508.

Science and Engineering
Public Policy majors must take two sequences in the sciences, for a total of 14-16 hours. At least one sequence must be a laboratory science (typically BIOL 1501-02, CHEM 1211-1311/1312, EAS 1600-01, or PHYS 2211-12). The second sequence must consist of courses chosen from an approved list of courses in science or engineering.

Computer Science
Students are required to complete CS 1301.

Humanities and Fine Arts
Students are required to complete ENGL 1101-02 and an additional 6 hours in the humanities and fine arts. Additional courses may be chosen from the list of approved humanities courses in this catalog. Public policy majors may not count PST courses for both their degree requirements and the Humanities and Fine Arts requirements.

Social Sciences
The 12-hour social sciences requirement may be satisfied by taking one of the following: HIST 2111, HIST 2112, INTA 1200, POL 1101, or PUBP 3000 (to satisfy state requirements regarding course work on the history and Constitutions of the U.S. and Georgia), plus 9 hours from the approved list of social science courses (history, economics, international affairs, political science, public policy, sociology, and psychology). Because POL 1101 is required for all B.S.P.P. majors, public policy majors are strongly urged to take POL 1101 to satisfy this requirement. Public policy majors may not count social science courses for both their degree requirements and the social science requirements.

Health and Performance Sciences
Students are required to complete HPS 1040 or 1061. The two credit hours earned for these courses do not count toward the 120-hour requirement for the B.S. degree.

Non-Major Cluster
Students must take a minimum of 12 hours from a list of courses related to the study of public policy. These courses include HIST 2112, ECON 2105, ECON 2106, and another history or sociology class from an approved list.

Senior Seminar/Thesis
A capstone course usually taken in the student's last term before graduation, the Senior Seminar and Thesis (PUBP 4600) involves writing an original policy analysis relevant to a public or nonprofit agency.

Free Electives
To graduate, each student must have accumulated at least 120 semester hours of credit toward the Bachelor of Science in Public Policy degree. Therefore, in addition to the requirements listed previously, the student must take a sufficient number of elective courses either within or outside Public Policy to reach 120 hours. Typically, this will allow the student approximately 18 hours of free electives.

Graduate Programs

Master's Program
The Master of Science in Public Policy is designed for students with strong analytical backgrounds, such as those received in engineering, natural science, or an analytically oriented social science or humanities curriculum. Graduate studies in public policy focus on areas in which either the consequences of scientific and technological activity have significant public policy implications, or technical and scientific information is a significant input to the policy-making process.

The M.S. in Public Policy requires 49 credit hours of study, including either (a) three hours devoted to producing a professional policy research paper or team research project or (b) nine hours for a thesis. In general, it is expected that students planning to enter employment upon completing the degree will choose the paper or project option, while students planning to continue their graduate work will choose the thesis option.

The program has a required core curriculum consisting of five substantive elements: policy and organizational analysis; ethics, philosophy, and public policy; economics and public finance; methods of analysis, including quantitative analysis and research design; and a capstone course in public policy analysis. In addition, there is a required one-credit hour introductory graduate seminar in public policy. There are 28 credit hours in the core curriculum. Based on prior course work or a test-out exam, students may request up to six credit hours of exemptions from core courses. In individual cases, students may be required to take pre-core preparatory courses to be ready for graduate studies in particular methodological or analytical areas. Core courses include:

PUBP 6001	Introduction to Public Policy
PUBP 6010	Ethics, Epistemology, and Public Policy
PUBP 6012	Fundamentals of Policy Processes
PUBP 6112	Research Design in Policy Science
PUBP 6114	Applied Policy Methods and Data Analysis
PUBP 6116	Microeconomics for Policy Analysis
PUBP 6118	Public Finance and Policy
PUBP 6201	Public Policy Analysis

Plus two of the following:

PUBP 6014	Organization Theory
PUBP 6017	Public Management
PUBP 6018	Policy Implementation and Administration

Although the curriculum is sufficiently flexible to accommodate the interests of students in many policy areas, students generally focus on one or more of the following areas of concentration: science and technology policy, environmental policy, information policy, or urban and regional development policy. Students are encouraged to develop their own programs of study, usually based in one of these areas, by taking courses and conducting research in other Georgia Tech schools, including those in the Ivan Allen College, Architecture, Management, Sciences, and Engineering.

The first year emphasizes core courses in policy processes and methods of analysis, while the second year focuses on electives in the student's area of concentration. Students must achieve a grade of *B* or higher in all core courses. A summer internship, work experience, or co-op assignment between the first and second year offers the student insight into a research or professional setting related to his or her career interests. Regardless of the areas of concentration, students will pursue rigorous analytical study based in the social sciences, engineering, science, planning, management, and the humanities appropriate for understanding the complex relationships among science, technology, and public policy.

Doctoral Program

The Ph.D. in Public Policy prepares students for advanced professional work or for academic careers. The program leading to the Ph.D. in Public Policy stresses intellectual and methodological rigor, building upon the theory and applications of quantitative analysis, political and organizational analysis, research design, and economics.

All students must have completed the equivalent of the core courses for the Master of Science in Public Policy (see description of the M.S. degree). The doctoral degree is built upon a core curriculum of 18 credit hours (6 three-credit hour courses). These courses are designed to provide students with a theoretical and methodological foundation for conducting public policy research. Core courses include:

PUBP 8200	Advanced Research Methods I
PUBP 8205	Advanced Research Methods II
PUBP 8211	Microeconomic Theory and Applications
PUBP 8500	Research Seminar in Public Policy
PUBP 8510	Logic of Policy Inquiry
PUBP 8520	Scope and Theory of Public Policy

This core is supplemented with in-depth study of particular substantive areas of public policy. The program focuses on three substantive specialties: science and technology policy, environmental policy, and urban and regional development policy. Students may pursue concentrations with groups of courses already developed by the faculty or an individualized concentration with the written approval of the student's advisor and the Graduate Committee. A major area of concentration has a capstone seminar at the Ph.D. level that majors are required to complete. The minor concentration is an area of study that is taken outside the School of Public Policy. A student's advisor, in conjunction with the School of Public Policy Graduate Committee, determines the total number of hours required under a major and minor concentration. In most instances the major will consist of four classes (12 credit hours) and the minor will consist of three classes (9 credit hours).

Other requirements for the Ph.D. include completion of the one-year residency requirement; admission to candidacy for the degree through completion of a qualification process (3 credit hours of preparation for Ph.D. qualifiers and 3 credit hours of dissertation colloquium); and completion and successful defense of a doctoral dissertation (9 credit hours).

In summary, the credits required for the Ph.D. are usually as follows:

Core	18 hours
Major	12 hours
Minor	9 hours
Qualifiers	3 hours (written exam)
Colloquium	3 hours (oral exam: presentation of dissertation proposal)
Dissertation	9 hours
Total	54 hours

This total assumes that a student already has satisfied the core requirements of the master's degree (at most an additional 28 hours).

Joint Program with Georgia State University

The School of Public Policy at Georgia Tech also offers a Ph.D. degree in a joint program with Georgia State University's School of Policy Studies. For information about this program, contact the graduate director.

Financial Aid

All Ph.D. students receive financial assistance, chiefly through sponsored research projects and teaching assistantships.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

(Core courses are marked with a *, with 1000-4000 numbers for BSPP, 6000 numbers for MSPP, and 8000 numbers for the Ph.D. Additional PST courses appear under Philosophy, Science, and Technology.)

POLITICAL SCIENCE

POL 1101. Government of the United States
3-0-3.
The purposes, structure, and functions of national and state governments, focusing on participation, institutions, and the policy process. Foundations of law, civil rights and civil liberties, role of the media, parties and elections, and policy processes.

PHILOSOPHY OF SCIENCE AND TECHNOLOGY

PST 2050. Philosophy and Political Theory
3-0-3.
Survey of political thought from ancient times, relating classical and modern political theories to problems of the modern democratic state. Special emphasis on the problems of the individual and state.

PST 2068. Science and Values in the Policy Process
3-0-3.
Normative and logical structures of policy analysis, with applications of moral theories and deductive reasoning to cases in policy analysis. Frameworks include utilitarianism, benefit/cost analysis, and rights theories.

PUBLIC POLICY

PUBP 2012. Foundations of Public Policy
3-0-3.
An in-depth exploration of American public policy, with emphasis on the dynamics of policymaking in policy areas such as health care, research, energy and environment, income maintenance, and economic development.

PUBP 2014. Legislative Process
3-0-3.
Analysis of the legislative process with a focus on institutional roles and group dynamics, including selection of legislators, interaction with other governmental institutions, and the role of analysis in shaping legislation.

PUBP 3000. American Constitutional Issues
3-0-3.
Examines the American social and political system through the prism of Constitutional issues decided by the U.S. Supreme Court.

PUBP 3010. Bureaucracy and Policy Implementation
3-0-3.
An exploration of the roles and activities of bureaucracies in the implementation of policies and programs, with emphasis on practical issues of public management.

PUBP 3016. Judicial Process
3-0-3.
The functions, structures, and procedures of state and federal court systems, including selection and appointment of judges, judicial activism, influences on court decisions, and enforcement of court decisions.

PUBP 3110. Research Methods and Problem Solving
3-0-3.
Conceptual and methodological issues in policy studies, including causality, explanation, models, threats to research, data collection, and assesment of applicability to policy issues. Design of research strategies.

PUBP 3113. Statistical Analysis for Public Policy
3-0-3.
This course provides a basic introduction to 1) probability, 2) descriptive statistics, 3) inferential statistics and regression analysis, and 4) microcomputer spreadsheets. The course emphasizes application of basic statistical concepts to typical public policy and administration problems.

PUBP 3200. Metropolitan Governance
3-0-3. Prerequisite(s): POL 1101.
Explores the dilemma of fragmented governance, shared problems and political entrenchment, which poses challenges to regional cooperation in metropolitan areas, focusing on environmental, transportation, and public service issues.

PUBP 3201. Introduction to Social Policy
3-0-3.
A survey of public policies directed toward social problems in America and their evolution and reform. Development of role of government in addressing issues related to poverty and social welfare.

PUBP 3212. State Policymaking
3-0-3.
This course provides an introduction to politics at the state and local levels of government.

PUBP 3214. African-American Politics
3-0-3.
An exploration of the organizations, strategies, and issues that have defined African-American political life in the post-civil rights era in the U.S.

PUBP 3600. Sustainability, Technology, and Policy
3-0-3.
Ethical, scientific, technological, economic, and political dimensions of sustainable human practices, applying multidisciplinary perspectives to challenges facing public- and private-sector approaches to sustainability.

PUBP 3610. Pre-Law Seminar
3-0-3. Prerequisite(s): PUBP 3000 or PUBP 3016.
Examination of the legal profession and areas of legal specialization (e.g., contract, property, intellectual property, international). Emphasizes skills and values that are essential to success in law school and competent lawyering.

PUBP 4120. Survey Research Methods
3-0-3.
Methods for producing and reporting valid surveys, including composition of questions, design and implementation of survey strategies, and analysis and communication of results.

PUBP 4130. Policy Analysis and Program Evaluation
3-0-3. Prerequisite(s): PUBP 3110
Analytical methods for rational planning and policy analysis, emphasizing "learning by doing" as students examine alternative types of policy analysis, establish evaluation criteria, and evaluate policy implementation.

PUBP 4200. Social Policy Issues
3-0-3. Prerequisite(s): PUBP 3201.
A review of conceptual and analytical perspectives in social policy and coverage of major areas of persistent social problems, including health care, welfare reform, housing, education, reproductive issues, and gerontology.

PUBP 4211. Urban Policy
3-0-3. Prerequisite(s): POL 1101.
Urban policy and urban economic development examined historically, nationally, and locally. Approaches to urban development and redevelopment.

PUBP 4212. Women and Public Policy
3-0-3.
The status of women in American society as a function of rights and opportunities conferred upon women by governmental actions and as influenced by forces of social change.

PUBP 4226. Business and Government
3-0-3.
How government regulates business and markets, and how business exercises power and influence on government in areas such as antitrust, financial markets, safety and health, and environmental quality.

PUBP 4314. Environmental Policy and Regulation
3-0-3. Prerequisite(s): POL 1101.
Using case studies of local, national, and international environmental issues, this course examines the roles of economics, law, political institutions, science, and technology in shaping environmental policies.

PUBP 4316. World Food, Population, and Environment
3-0-3. Prerequisite(s): POL 1101.
Interdisciplinary perspectives on relationships among technology, markets, and the structure of social institutions in responding to the challenge of managing an expanding world economy with growing consumption demands.

PUBP 4338. Environmental Impact Assessment
3-0-3.
Examines policy, planning, and methodological issues in the environmental impact assessment of engineering systems. Emphasizes regulatory aspects of environmental analysis and key analytical techniques, and the incorporation of environmental considerations into engineering design processes.

PUBP 4410. Science, Technology, and Public Policy
3-0-3.
Examination of relationships between science, technology, and government, and their mutual influence on public and private decisions.

PUBP 4414. Technology, Innovation, and Policy
3-0-3.
Theories and concepts of technological innovation and diffusion, economic development, and the role of public and private institutions in technological development at the firm, industry, regional, national, and international levels.

PUBP 4416. Critical Issues in Science and Technology
3-0-3.
Exploration of technology and technological society, going beyond utility and functionality to consider justice, meaningfulness, and self-realization. Perspectives include political economy, aesthetics, and social change.

PUBP 4512. Politics of Telecommunication Policy
3-0-3. Prerequisite(s): POL 1101.
A review of the politics and environment of telecommunication policymaking, including the role of communication in society, the impact of government on the evolution of communications technologies, and proposals for reform.

PUBP 4514. Mass Communication Policy
3-0-3. Prerequisite(s): POL 1101.
Examines mass media influences, activities, characteristics, and behavior with respect to the political process and government. Structure of media markets, characteristics of news and advertising, and impacts of changing technologies on political processes.

PUBP 4530. Introduction to Geographic Information Systems
3-0-3.
Overview of GIS concepts, methods, and terminology. Introduction to PC-based GIS software. Applications to marketing, natural resource management, and public information systems. Students use case studies to design and implement actual projects.

PUBP 4532. Advanced GIS Topics: Spatial Analysis, GIS Programming, and Map Internet Server
3-0-3. Prerequisite(s): PUBP 4530.
Introduction to raster-based GIS software, Avenue script language, and Map Internet Server. Applications to marketing, natural resource management, and public information systems.

PUBP 4600. Senior Seminar/Thesis
3-0-3.
A capstone course usually taken in the student's last term before graduation, the Senior Seminar and Thesis involves writing an original paper entailing policy analysis relevant to a public or nonprofit agency.

PUBP 4756. Technology Forecasting and Assessment
3-0-3.
Develops skills in methods for technology monitoring, forecasting, and assessement; draws on examples in various emerging technologies. Collection and analysis of quantitative and qualitative data on emerging technologies and their implications. Crosslisted with ISYE 4756

PUBP 4801,-2,-3. Special Topics
3-0-3, each.

PUBP 4875,-6,-7. Special Topics in Political Science
3-0-3, each.

PUBP 4901,-2,-3. Special Problems
Credit hours to be arranged.

PUBP 4951. Georgia Internship Program
3-0-3. Prerequisite(s): POL 1101
Work-study program assigning students to a project in state or local government. Students prepare research papers analyzing their work experiences relative to theory from the social science or policy studies.

PUBP 4952. Legislative Internship Program
3-0-3. Prerequisite(s): POL 1101.
Students work full time for the Georgia General Assembly for elected officials or committees. Students prepare research papers analyzing their work experiences relative to theory from the social science or policy studies. Spring semester only.

PUBP 6001. Introduction to Public Policy
1-0-1.
An introduction to the field of public policy, including an overview of the scope of the field and examples of public policy analysis.

PUBP 6010. Ethics, Epistemology, and Public Policy
3-0-3.
Examination of the role of ethics and epistemology in public decision making including the effects of values of professionals on public institutions and private-sector organizations.

PUBP 6012. Fundamentals of Policy Processes
3-0-3.
The political and governmental context of policy is presented, from agenda-setting to evaluation. Examines constitutional and federal contexts of policy, the role of various input mechanisms in shaping policy decisions, the processes by which government institutions make decisions (and the interactions among these institutions), and approaches for understanding and anticipating policy decision making.

PUBP 6014. Organization Theory
3-0-3.
A broad overview of the theoretical issues pertaining to the management of organizations. The course explores both "macro" (i.e. external relations, strategies, and structures) organizational issues. While this is a survey course, we will be concentrating much of our attention on current challenges to bureaucracy as a form of organization. In particular we will be using theories to examine trends toward re-engineering corporations or re-inventing government agencies. Satisfies policy implementation, management, and organization theory requirement.

PUBP 6017. Public Management
3-0-3.
Using case studies and a field exercise, students will examine how public policies are executed and managed. Underlying the course is the assumption that public management is the management of political authority and that strategic thinking can make for effective public management. Satisfies policy implementation, management, and organization theory requirement.

PUBP 6018. Policy Implementation and Administration
3-0-3.
This course gives special attention to institutional processes in efforts to coordinate policy implementation at the federal level and within the intergovernmental context; the analysis of implementation and enforcement of policy by regulatory agencies with the support of state governments and private-sector agents; challenges to implementation by policy type; and the analysis of policy tools and administrative discretion in implementation. Satisfies policy implementation, management, and organization theory requirement.

PUBP 6112. Research Design in Policy Science
3-0-3.
The objectives for this course include: (1) providing a broad overview of research methods and research criteria; (2) giving students the opportunity to conduct data-based research and analysis; (3) providing more specialized knowledge of one set of research techniques (e.g. survey research, case studies, experimentation - varies by term); (4) providing experience in presenting and defending research.

PUBP 6114. Applied Policy Methods and Data Analysis
3-0-3. Prerequisite: Students without preparation in basic statistical concepts and computer methods will be required to take appropriate courses at the 4000 level prior to admission to this course.
This course will focus on how to design, carry out, present, and interpret quantitative analyses of policy problems. Topics include probability, inferential statistics, regression analysis, general linear models, non-parametric analyses, and graphical analysis, as time permits. Classes will focus on, (1) the course project, (2) discussions of assigned readings and problems, (3) data analysis using spreadsheets and a standard statistical package.

PUBP 6116. Microeconomics for Policy Analysis
3-0-3.
Microeconomic theory is studies with applications to public problems. Students will be introduced to price-generating processes in an economy, demand and supply theory, market equilibrium, welfare economics, categories of market failure and the public sector's role.

PUBP 6118. Public Finance Policy
3-0-3.
Examines the theory, practice, anad policy implementations of federal, state, and local government budgeting and finance. Topics include government spending decisions with a focus on aggregate demand and supply, fiscal policy, budgeting practice, introduction to cost/benefit analysis.

PUBP 6201. Public Policy Analysis
3-0-3.
This course provides a capstone experience for public policy students. The course addresses real-world policy issues and various approaches to analyzing them. The course relies heavily on cases and exercises.

PUBP 6218. Quantitative Models in Public Policy
3-0-3. Prerequisite(s): PUBP 6114.
This course lays a foundation for model-building, and through the introduction of a variety of software packages will provide some hands-on experience with elementary model building. Decision models will be emphasized. Some familiarity with data analysis, probability, and statistical models is assumed. The goal of the course is to equip students with basic model building tools, familiarize them with common problems in modeling, and improve their ability to create and evaluate simple models of policy problems.

PUBP 6221. Policy and Program Evaluation
3-0-3.
Approaches to evaluation policies and programs are presented using examples and case studies to contrast evaluation methods as well as the organizational and political context for evaluation.

PUBP 6226. Business and Government
3-0-3.
Examines government regulation of business operations and the economy from a broad perspective.

PUBP 6300. Earth Systems
3-0-3.
Describes the scientific principles and interactions that make up the Earth's environmental system. The course examines the interaction of natural and human influences that shape the development and operation of the Earth system and how public and private decision making impacts this system.

PUBP 6310. Environmental Issues
3-0-3.
Provides an overview of basic concepts and methods of environmental policy analysis and implementation through a case study approach. Cases will range from local to global environmental policy issues. The goal of the course will be to expose students to the broad range of social and physical problems referred to as "environmental" problems, and to orient the student for future work in the field.

PUBP 6312. Economics of Environmental Policy
3-0-3.
This course addresses key concepts in environmental economics, including externalities, efficiency, social welfare, and environmental quality as a public good. Addresses environmental problems (i.e. water resources, air quality, urbanization) and vehicles of collective environmental action.

PUBP 6314. Policy Tools for Environmental Management
3-0-3.
Explores the various regulatory, managerial, and legal mechanisms available to policy analysts and decision makers for protecting environmental quality.

PUBP 6320. Sustainable Systems: Concepts and Measures
3-0-3.
This course is a historical introduction to sustainable development. The ethical, economic, ecological, and technological dimensions of sustainability are examined. Topics include sustainable development in developing and developed countries; ecosystem health and resilience; the global carrying capacity controversy; sustainable communities, new urbanism, regenerative technologies; designs for disassembly; appropriate technologies, and the politics of technologies.

PUBP 6324. Environmental and Technological Risk Management
3-0-3.
Introduction to analytical, social, and policy issues that comprise environmental and technological risk management. Provides an understanding of how risk can be incorporated into decision making; and the role of information in quantifying risk. Analyzes case studies to see why it is important to take risk into account, and examines the role of risk management in promoting environmental protection, safety, and health.

PUBP 6326. Environmental Values and Policy Goals
3-0-3.
Examines the goals and objectives of environmentalists, with special attention to the literature of environmental ethics.

PUBP 6329. Environmental Policy and Implementation
3-0-3.
The concepts and methods of environmental policy analysis and implementation are presented through a case study approach.

PUBP 6330. Environmental Law
3-0-3.
Presents the legal and institutional framework within which environmental law is developed and implemented in the U.S. and internationally. Also examines the major pollution control statutes, and reviews international law and conventions to address trans-boundary environmental issues.

PUBP 6401. Science, Technology, and Public Policy
3-0-3.
Examination of the relationships between science, technology, and government, including policies for support, control, and application of science and technology.

PUBP 6402. Research Policy and Management
3-0-3.
Examines challenges in research policy and management. The research activities of public, private, and not-for-profit organizations are contrasted in examining strategic planning, allocation of resources, technology transfer, and research evaluation practices.

PUBP 6414. Technological Innovation and Government Policy
3-0-3.
Federal and state policies to stimulate innovation; sources and stimuli for innovation; role of universities and industry consortia; comparative innovation policy; evaluation of technology policy.

PUBP 6415. Technology, Regions, and Policy
3-0-3.
Explores concepts, issues, and policies related to regional development, economic development, industrial change, and technology policy.

PUBP 6417. Critical Perspectives on Science and Technology
3-0-3.
This course seeks to stimulate students' critical thinking about science and technology and their relationships to markets, politics, and societies. Discussions include topics such as the social organization of scientific and technical communities, the roles of economic and political forces in science and technology, the shaping of the technical workforce, and the implications of science and technology for concepts that go beyond utility and competitiveness to include justice and self-realization.

PUBP 6421. Development of Large-Scale Socio-Technical Systems
3-0-3.
Analyzes development of large systems such as smart highways, computer networks, electrical power, weapons, and space. Teaches practical skills including negotiation, coalition-building, strategy, and innovation politics.

PUBP 6501. Information Policy and Management
3-0-3.
Examination of the information age from policy and management perspectives. The course will explore concepts and issues related to the formation and implementation of information policies.

PUBP 6513. The Politics of Communications Policy
3-0-3.
An examination of the political process that makes communications policy. The course covers the historical origins of government management of communications, Federal Communications Act, Federal Communications Commission, Congress, judiciary, executive, and special interest activity. Communications is compared to other types of policies. The discussions include historical and contemporary communications issues.

PUBP 6514. Mass Communications Policy
3-0-3.
Traces the evolution of broadcasting, cable, and other mass media policies. Examines the functioning/impact of mass communications in a changing technological environment.

PUBP 6530. Introduction to Geographic Information Systems
3-0-3.
Introduction to the application of geographic information systems (GIS) to public policy issues. Students develop an understanding of GIS software and hardware components, develop facility with a desktop GIS software package, explore digital data availability on the Internet, learn data transfer procedures, learn cartographic projection methods, apply GIS and environmental management data to analyze a selected program.

PUBP 6534. Public Information Systems
3-0-3.
Design, development, and management of information systems for the public sector.

PUBP 6600. Foundations of Local Economic Development Planning and Policy
3-0-3.
Introduction to the context, theory, process, and practice of local economic development planning and policy. Topics covered include differing theoretical and conceptual explanations of the economic development process; international, national, and regional factors affecting local economic development; federal, state, and local roles; key elements in the economic development process; and contrasting economic development approaches.

PUBP 6602. Economic Development Analysis and Practice
3-0-3.
Strategy development, methods of analysis, and approaches to practice for urban and regional economic development policy and planning.

PUBP 6604. Methods of Urban Policy Analysis and Planning
3-0-3.
Applies analytical techniques and practices of public policy and planning to urban issues, synthesizing varied public policy techniques and practices in a case study context.

PUBP 6606. Urban Development Policy
3-0-3.
Introduces elements of urban policy and urban economic development by examining them historically, nationally, and locally. Approaches to urban development and redevelopment are analyzed.

PUBP 6608. Management of Technology: External Environment
3-0-3.
Examines factors in external environment essential to managing technology. Considers technological innovation process in context of international competitiveness and roles of governments.

PUBP 6753. Comparative Science and Technology Policy
3-0-3.
Examination of the social, political, and cultural contexts of science and technology, and how they affect the research, development, and regulatory policies of nations. Crosslisted with INTA 6753.

PUBP 6777. Analysis of Emerging Technologies
3-0-3.
This course develops skills in the use of selected methods for technology monitoring, forecasting, and assessment. Also examines current status and prospects in selected emerging technology domains. Crosslisted with ISYE 6777.

PUBP 6780. Knowledge Management
3-0-3. Prerequisite(s): MGT 6050.
This course enables students to conceptually think about the modern organization as a knowledge-based, information-processing enterprise and to acquire analytical skills necessary to be a successful manager of a knowledge-based organization. Case studies and an organizational audit are used to examine knowledge-based organizations. Crosslisted with MGT 6780.

PUBP 6801. Research Paper
3-0-3.
Either a professional policy research paper or a team research project including a co-authored policy research monograph prepared for a government or public affairs client.

PUBP 7000. Master's Thesis
Credit hours to be arranged.

PUBP 8200. Advanced Research Methods I
3-0-3.
The course will cover advanced analytical and modeling methods. Topics may include: nonparametric statistical methods, path analysis, principle component and factor analysis of econometrics.

PUBP 8205. Advanced Research Methods II
3-0-3.
Experimental and quasi-experimental design, survey research methods, and evaluation. Case study and qualitative analysis may also be included.

PUBP 8211. Microeconomic Theory and Applications
3-0-3.
Extensions of microeconomic theory-consumer theory, firm theory, and markets-to-situations involving many periods and uncertainty. Introduces students to general equilibrium, externality, and welfare economics.

PUBP 8500. Research Seminar in Public Policy
3-0-3. Prerequisite(s): PUBP 8205 and PUBP 8520.
Exploration of the purpose of and approaches used in public policy research. Requires development of original empirical research.

PUBP 8510. Logic of Policy Inquiry
3-0-3.
This course presents the conceptual foundations of models of policy inquiry. Topics include the scientific, rational-actor, and ethical models. The ethical values underlying cost benefit analysis, pareto-optimal models, and market models are also examined.

PUBP 8520. Scope and Theory of Public Policy
3-0-3.
Overview of core literature of public policy including theories of public policy, the history of public policy studies, the institutional structure of policy analysis, the profession of policy research, and the intellectual bases of public policy studies.

PUBP 8530. Advanced Science and Technology Policy
3-0-3.
Overview of core literature of technology and science policy, theories of innovation, intellectual foundations of technology and science policy.

PUBP 8540. Advanced Environmental Policy
3-0-3.
Overview of core literature of environmental policy, theories of environmental policy, intellectual foundations of environmental policy.

PUBP 8550. Advanced Urban and Regional Economic Development Policy
3-0-3.
Overview of core literature of economic development policy, theories of economic development in urban and regional settings, intellectual foundations of economic development policy.

PUBP 8590. Dissertation Colloquium
3-0-3.
Seminar focusing on dissertation research preparation, culminates in public colloquium in which students present preliminary dissertation proposal.

PUBP 8801,-2,-3. Special Topics
Credit and class hours equal last digit of course number..

PUBP 8811,-2,-3. Special Topics
Credit and hours equal last digit of course number

PUBP 8821,-2,-3. Special Topics
Credit and class hours equal last digit of course number.

PUBP 8831,-2,-3. Special Topics
Credit and class hours equal last digit of course number

PUBP 8900,-10,-20,-30,-40,-50. Special Problems
Credit hours to be arranged.

PUBP 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding a teaching assistantship.

PUBP 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding a research assistantship.

PUBP 8999. Preparation for the Doctoral Qualifying Examination
Credit hours to be arranged.

PUBP 9000. Doctoral Thesis
Credit hours to be arranged.

Women, Science, and Technology

Faculty Coordinators–Mary Frank Fox, Professor, School of History, Technology, and Society (HTS); Carol Colatrella; Associate Professor, School of Literature, Communication, and Culture (LCC); *Professors*–Lawrence Foster, HTS; Nancy Nersessian, LCC; *Associate Professors*–Anne Balsamo, LCC; Richard Grusin, LCC; Daniel Kleinman, HTS; Alan Rauch, LCC; Carol Senf, LCC; Andrea Tone, HTS; Steven Vallas, HTS; *Assistant Professors*–Michael Allen, HTS; Alice Bullard, HTS; Chiquita Collins, HTS; Deborah Grayson, LCC; Rebecca Merrens, LCC; Kavita Philip, LCC; Ellen Strain, LCC.

General Information

The Women, Science, and Technology (WST) program does what no other gender studies program does–it links science and technology issues to those issues more traditionally associated with women's studies. The WST minor prepares Tech students–women and men majoring in engineering, science, social sciences, and humanities–to live and work in an increasingly diverse world. The minor helps students develop their understanding of the human side of science and engineering, involving not only gender issues, but inequalities of race and class as well.

WST courses reflect on the theoretical and practical dimensions of diversity. Students are encouraged to explore the values associated with scientific culture and to learn to synthesize knowledge across the disciplines, while viewing science and engineering as social and cultural forces that shape relations among women and men.

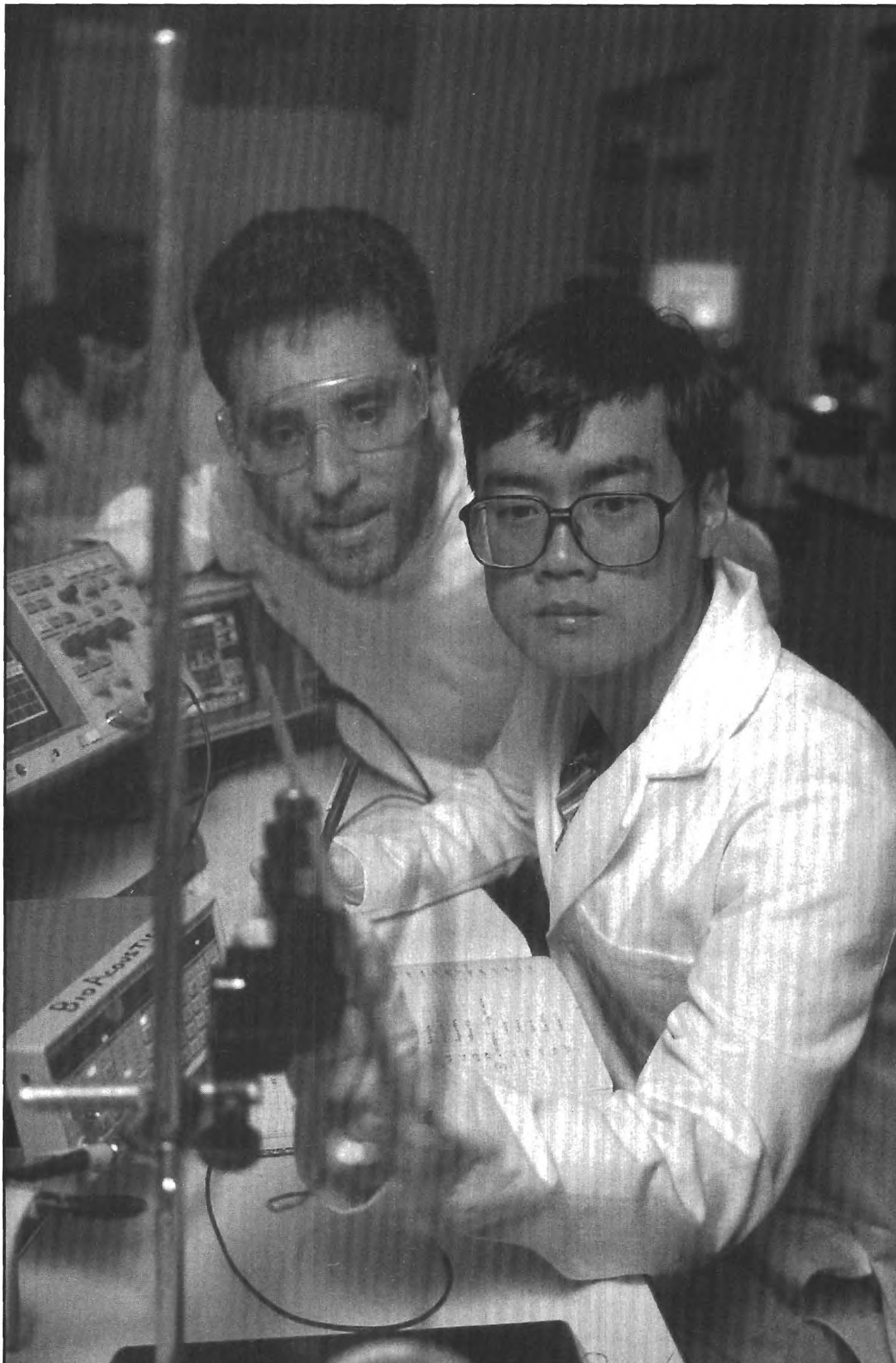
A WST minor must take the following Institute prerequisites (or their equivalents): ENGL 1101: English Composition, ENGL 1102: English Composition, and one of the following: HIST 2111: U.S. History to 1877; HIST 2112: U.S. History Since 1877; POL 1101: American Government; PUBP 3000: American Constitutional Issues; INTA 1200: American Government in Comparative Perspective. Each minor must take the following two (2) required courses: HTS 3021: Women in Science and Engineering; LCC 3304: Science, Technology, and Gender. Each minor must also take four (4) courses from the following HTS and LCC courses, at least one of which should be from the HTS, and one from the LCC, list. With permission of the WST co-coordinators, a student may substitute one related course (described below). Each student must have at least 12 credit hours of 3000- and/or 4000-level courses, and a total of 18 credit hours must be presented for the WST minor.

History, Technology and Society
HTS 2082: Technology and Science in the Industrial Age
HTS 2084: Technology and Society
HTS 3007: Sociology of Work, Industry, and Occupations
HTS 3016: Women and Gender in the United States
HTS 3017: Sociology of Gender
HTS 3082: Sociology of Science
HTS 3084: Culture and Technology
HTS 3086: Sociology of Medicine and Health

Literature, Communication and Culture
LCC 2100: Introduction to Science, Technology, and Culture
LCC 3224: Gender Studies
LCC 3306: Science, Technology, and Race
LCC 3302: Science, Technology, and Ideology

LCC 3308: Environmentalism and Ecocriticism
LCC 3316: Science, Technology, and Postcolonialism
LCC 3318: Biomedicine and Culture

With permission of WST co-coordinators, students may substitute one appropriate course not listed above under HTS and LCC. This may be chosen from special topics courses, seminars, and other courses in the Ivan Allen College, that focus upon gender and social inequality or social issues of science and technology. Students may register and plan their courses of study for the WST minor by meeting with one of the co-coordinators, Mary Frank Fox (HTS) and Carol Colatrella (LCC). Students petition for the minor at the time they petition for their major degree. Minors are conferred upon graduation and appear on students' transcripts.



College of Sciences

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Dean–Gary B. Schuster; *Associate Deans*–E. Kent Barefield, Anderson D. Smith; *Director of Development*–Blythe Keller; *Director of Finance*–Patricia Ledon; *Director of Facilities*–Gerald E. O'Brien.

General Information

The College of Sciences comprises six schools–Biology, Chemistry and Biochemistry, Earth and Atmospheric Sciences, Mathematics, Physics, and Psychology, each offering both undergraduate (B.S.) and graduate degrees (M.S. and Ph.D.) and one nondegree-granting department, Health and Performance Sciences. The Center for Education Integrating Science, Mathematics, and Computing (CEISMC), which works with K-12 schools and teachers in the state of Georgia to improve science and mathematics education, is also a unit of the College of Sciences.

The College of Sciences provides the courses in mathematics and the natural sciences that are necessary for all Tech undergraduates to acquire skills and basic principles for their majors. A detailed description of each degree program in the College of Sciences is located under the appropriate school heading, as are descriptions of the courses offered. College of Sciences' courses required or recommended by degree programs in the other five colleges at Georgia Tech are listed under the curricula for those degrees.

A joint program with Georgia State University makes it possible for students at Georgia Tech to obtain T-4 Teacher Certification in biology, chemistry, earth sciences, mathematics, physics, or broad-field science while pursuing their Georgia Tech degree. T-4 certification permits the recipient to teach in secondary schools (grades 7-12) in Georgia or in the 35 states having reciprocity with Georgia.

The College of Sciences does not currently offer minors, but does offer a number of certificate programs that provide similar opportunities for students to develop their expertise or acquire skills or information in specific areas in addition to their major area. Students who satisfactorily complete these programs will receive a certificate of recognition from the department that offers the program. Certificate programs available in the College of Sciences are as follows:

(Certificate programs offered by the other colleges at Georgia Tech are also available to students in the College of Sciences.)

Certificate Programs in the College of Sciences

Chemistry and Biochemistry
- Biochemistry/Organic Chemistry
- Chemical Analysis
- Physical/Inorganic Chemistry

Earth and Atmospheric Sciences
- Geochemistry
- Geophysics

Health and Performance Sciences and Biology
- Health Sciences

Physics
- Applied Optics
- Computer-Based Instrumentation
- Atomic, Molecular, and Chemical Physics

Psychology
- Biopsychology
- Engineering Psychology
- Experimental Psychology
- Industrial/Organizational Psychology
- Social/Personality Psychology

School of Biology

Established in 1960
Location: Cherry Emerson Building
Telephone: (404) 894-3700
Website: www.gatech.edu/biology

Chair and Professor–Roger M. Wartell; *Harry and Linda Teasley Chair in Environmental Biology and Professor*–Mark Hay; *Professors*–Mark Borodovsky, David B. Dusenbery, Dwight H. Hall, Terry W. Snell, Thomas G. Tornabene, *Associate Professors*–Jung Choi, E. Lloyd Dunn, Paul Edmonds, Gunther U. Holzer, Joseph Montoya; *Assistant Professors*–Yury Chernoff, Thomas J. DiChristina, Feng Dong, Patricia Sobecky, Marc Weissburg; *Research Scientist*–David Garton; *Adjunct Faculty*–Leonid Bunimovich, Marc Frischer, Diane Lavett, Mindy Millard-Stafford, Peter Verity.

General Information

Programs of study offered by the School of Biology allow students to gain competence in the areas of environmental biology, microbiology, and molecular cell biology and genetics. The curricula in all degree programs in the School encourage breadth by incorporating course selections from other schools and departments. The Institute, with its strengths in science, computing, mathematics, and engineering, provides unique opportunities for careers in the biological sciences and related areas.

The Bachelor of Science degree program consists of a combination of requirements and electives that ensure a balanced background in the fundamental areas of biology, while providing an opportunity to emphasize an area of interest in the junior and senior years. The School also offers graduate programs leading to the M.S. and Ph.D. degrees. The degree programs include course work, faculty and student seminars, and independent research. Faculty members are actively engaged in research fields such as bioinformatics, bioremediation, biophysics, chemical ecology, microbiology, and molecular biology/genetics.

Undergraduate Program

The undergraduate curriculum for the Bachelor of Science in Biology degree is well suited to prepare students for employment in research and other technical positions; for graduate studies in the biological sciences; or for admission to medical, dental, veterinary, or other professional schools. The minimum number of total hours required for a bachelor's degree is 122. Many students make use of the opportunity to participate in faculty-directed research through special problems courses, which may be used for technical elective credit. The School also offers a minor in Biology, as well as certificate programs.

Bachelor of Science in Biology (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
MATH 1501	CALCULUS I	4
CHEM 1211	GENERAL CHEMISTRY	4
BIOL 1510	BIOL. PRINCIPLES	4
ENGL 1101	ENGLISH COMPOSITION I	3
TOTAL SEMESTER HOURS		15

First Year - Spring Semester

Course Number/Name		*Hours*
MATH 1502	CALCULUS II	4
CHEM 1311	INORGANIC CHEMISTRY I	3
CHEM 1312	INORGANIC LAB I	1
BIOL 1520	INTRO. ORGANISMAL BIOL	4
ENGL 1102	ENGLISH COMPOSITION II	3
TOTAL SEMESTER HOURS		15

Second Year - Fall Semester

Course Number/Name		*Hours*
BIOL 2334	GENETICS[1]	4
CHEM 2311	ORGANIC CHEMISTRY I	3
CS 1301	COMPUTER SCIENCE 1	3
HIST 2111 or 2112 or POL 1101 or PUBP 3000	or INTA 1200	3
HPS 1061/1040	WELLNESS	2
TOTAL SEMESTER HOURS		15

Second Year - Spring Semester

Course Number/Name		*Hours*
BIOL 2335	GENERAL ECOLOGY[1]	3
PHYS 2211	PHYSICS I	4
CHEM 2312	ORGANIC CHEM II	3

CHEM 2380	SYNTHESIS LAB I	2
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		15

Third Year - Fall Semester

Course Number/Name		*Hours*
BIOL 3332	STATISTICAL METHODS	4
BIOL 3310	INTRO. MICROBIOLOGY[1]	4
PHYS 2212	PHYSICS II	4
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		15

Third Year - Spring Semester

Course Number/Name		*Hours*
BIOL 3331	CELL BIOLOGY[1]	4
BIOL TRACK ELECTIVE[2]		3
BIOL PROJECT LAB		3
SOCIAL SCIENCE ELECTIVES		6
TOTAL SEMESTER HOURS		16

Fourth Year - Fall Semester

Course Number/Name		*Hours*
BIOL TRACK ELECTIVE		3
TECHNICAL ELECTIVES		5
FREE ELECTIVES		5
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		16

Fourth Year - Spring Semester

Course Number/Name		*Hours*
TECHNICAL ELECTIVES		6
FREE ELECTIVES		8
BIOL 4450	SENIOR SEMINAR	1
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

1 - The core biology courses (Ecology, Genetics, Statistical & Mathematical Biology, Introductory Microbiology, Cell Biology) may be taken in any order.

2 - Each student must select one of three track options; Environmental Biology, Microbiology, or Molecular Biology/Genetics. Track electives and technical electives are selected from a list for each track obtained from the School of Biology.

Electives

Humanities and Social Sciences Electives

See "Core Curriculum," Information for Undergraduate Students, pages 33-34, for lists of approved courses. All students are required to take one course from HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200 to satisfy state requirements regarding the history and Constitutions of the U.S. and Georgia; an additional nine hours of social sciences; and six hours of humanities.

Track, Technical, and Free Electives

Track electives: Students select one of the three tracks in their junior and senior years and are required to take the project lab course in that track and two courses from a group associated with the track. Courses must be taken for a letter grade.

Technical electives: Eleven hours must be earned in courses chosen from a list approved by the School of Biology (available in the School of Biology's main office). The list includes upper-level biology courses, up to three hours of special problems research experience, as well as courses in other schools. Courses must be taken for a letter grade.

Free electives: The remaining 13 hours beyond courses required for humanities, social sciences, and physical education are free electives and may be taken on a pass/fail basis to the extent allowed under the catalog "Rules and Regulations" section.

Minor and Certificate Programs

A minor in biology is available to all non-biology majors. The minor program provides a concentration in modern biological sciences and is especially valuable for students considering biomedical or environmental fields. The basic requirement is 18 semester hours in biology, of which 12 hours must be at the 3000 level or higher. Further information is available from the School's undergraduate coordinator.

Certificate programs are available in Molecular Biology/Genetics, Environmental Biology, and Microbiology/Microbial Technology. A certificate requires a minimum of 12 hours in biology, at least 9 of which must be at the 3000 level or higher. Courses required by name and number in a student's major program of study shall not be counted toward the certificate. Further information is available from the undergraduate coordinator in the School of Biology.

Graduate Programs

The School of Biology provides advanced training and research opportunities in a variety of areas ranging from molecular biology to ecology. Some of the areas of current research are genomic sequence analysis, mechanisms of gene expression and DNA replication, signal transduction in plant and animal cells, environmental microbiology, bioremediation, sensory mechanisms in small animals, biological oceanography, and ecosystem toxicology.

Master of Science Degree

The requirements for the M.S. degree are a research thesis and 30 semester hours of class work, which includes 12 credit hours in a major field. Twelve of the semester hours must be in formal graduate-level courses. The thesis must be defended in an oral examination. A non-thesis master's degree is available for students unable to carry out a thesis project; information on its requirements is available from the graduate coordinator in the School of Biology.

Doctor of Philosophy Degree

Each Ph.D. student must acquire a thorough knowledge of a selected area of specialization, a broad knowledge of the field, and competence in the basic sciences. The main emphasis is on the successful completion of an original and independent research project. Credit hour requirements total 40, including 12 research credit hours and 9 credit hours in an approved minor. A maximum of 16 credit hours from an M.S. program may be applied to the doctoral program. Admission to candidacy requires passing a written comprehensive examination and an oral exam based on a written research proposal. Each Ph.D. student must write a comprehensive dissertation based on the student's scholarly research problem. Additional information on the graduate program is available from the graduate coordinator in the School of Biology.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

BIOLOGY

BIOL 1510. Biological Principles
3-3-4.
An introduction to the basic principles of modern biology, including biomacromolecules, bioenergetics, cell structure, genetics, homeostasis, evolution, and ecological relationships.

BIOL 1520. Introduction to Organismal Biology
3-3-4.
An introduction to biology at the organ and organismal levels, with emphasis on physiological processes and integration of growth and development.

BIOL 2334. Genetics
3-3-4. Prerequisite(s): BIOL 1510.
The principles of inheritance as described by Mendelian and biochemical genetics.

BIOL 2335. General Ecology
3-0-3. Prerequisite(s): BIOL 1510.
Introduction to the principles and implications of ecology, designed for biology majors and interested nonmajors. Emphasis on structure and function of natural populations, communities, and ecosystems.

BIOL 3310. Introductory Microbiology
3-4-4. Prerequisite(s): BIOL 1510 and BIOL 1520.
Basic biology of bacteria, fungi, algae, and viruses, with emphasis on bacteriology.

BIOL 3311. Cell Biology
3-3-4. Prerequisite(s): BIOL 1510 and CHEM 2311.
Structure and function of cells and their organelles.

BIOL 3332. Statistical Methods in Biology
3-3-4. Prerequisite(s): MATH 1502.
An introduction to statistical methods and their applications in the preparation and interpretation of biological experiments. Laboratory sessions emphasize numerical problem solving.

BIOL 3751. Human Anatomy and Physiology
3-0-3.
Study of human anatomy and fundamental physiological mechanisms. Topics include nervous, musculoskeletal, and cardiorespiratory systems. Free elective for biology majors. Crosslisted with HPS 3751.

BIOL 4010. Aquatic Ecology
3-0-3. Prerequisite(s): BIOL 2335.
Physics, chemistry, and ecology of aquatic communities and ecosystems. Physical, chemical, and biological investigations of lakes, streams, and estuaries.

BIOL 4220. Bacterial and Viral Genetics
3-0-3. Prerequisite(s): BIOL 3310 and BIOL 2334.
Bacterial and viral genetics with emphasis on the integration of genetic studies with biochemical and physical analysis of synthesis, structure, and function of nucleic acids and proteins.

BIOL 4290. Recombinant DNA Project Laboratory
1-6-3. Prerequisite(s): BIOL 2334.
Project lab focused on the methods of recombinant DNA technology, including preparation and cloning of DNA, PCR amplification, and biochemical methods of analysis.

BIOL 4340. Medical Microbiology
3-0-3. Prerequisite(s): BIOL 3310.
Advanced study of bacteria, protoza, fungi, and viruses that cause human diseases; emphasis on epidemiology, mechanisms of disease causation, prevention, and treatment.

BIOL 4390. Microbiology Project Laboratory
1-6-3. Prerequisite(s): BIOL 3310.
This project lab involves investigations on the physiology of growth and metabolic activities of microorganisms.

BIOL 4410. Microbial Ecology
3-0-3. Prerequisite(s): BIOL 3310 and BIOL 2335.
Advanced studies of microbial ecosystems, the specific roles of bacteria in maintaining ecological balance, and the evolution of the ecosystem in response to changing environments.

BIOL 4418. Microbial Physiology
3-0-3. Prerequisite(s): BIOL 3310 and BIOL 3331.
Study of the physiology of growth and metabolic activities of microorganisms.

BIOL 4423. Population Biology
3-0-3. Prerequisite(s): BIOL 2334 and BIOL 2335.
Population ecology and population genetics including: population structure, dynamics, modeling, demographic analysis, population regulation, genetic variation, selection, genetic drift, gene flow, genetic divergence, speciation.

BIOL 4430. Environmental Sustainability
3-0-3. Prerequisite(s): BIOL 1510 and BIOL 1520 and CHEM 1311.
A general survey of the responses of biological systems to various kinds of radiation and air or water pollution.

BIOL 4440. Plant Physiology
3-0-3. Prerequisite(s): BIOL 3331 and CHEM 2312.
Chemical transformation in photosynthesis, photophysiology and water relationships, organic nutrition and effects of hormones on growth and development of plants.

BIOL 4442. Plant Physiology Laboratory
0-6-2. Prerequisite(s): BIOL 3331 and CHEM 2312.
Experiments designed to familiarize students with current methods used in plant physiology and plant molecular biology. One or more weekend trips are usually included.

BIOL 4446. Animal Physiology
3-0-3. Prerequisite(s): BIOL 3331.
Systems physiology including nerves, muscles, kidney, digestion, circulation, endocrinology, reproduction, and respiration.

BIOL 4450. Senior Seminar
1-0-1.
Senior students' oral and written presentations of a recent research topic from one of the required project laboratories or from an individual project.

BIOL 4464. Developmental Biology
3-0-3. Prerequisite(s): BIOL 2334.
Investigations of cell differentiation and development using the tools of molecular genetics and cell biology.

BIOL 4469. Molecular Biology
3-0-3. Prerequisite(s): BIOL 1510 and BIOL 2334.
Topics in molecular biology of genetic processes, including: genetic engineering techniques, gene expression and regulation, genome structure and stability, molecular evolution. Emphasis on eukaryotic organisms.

BIOL 4471. Behavioral Biology
3-0-3. Prerequisite(s): BIOL 1510 and MATH 1502 and PHYS 2212.
An introduction to the study of the principles of behavior of all kinds of organisms, from microbes to mammals.

BIOL 4478. Biophysics
3-0-3. Prerequisite(s): BIOL 1510 and PHYS 2212.
Biophysical aspects of nucleic acids, proteins, and their interactions.

BIOL 4490. Ecology Project Laboratory
1-6-3. Prerequisite(s): BIOL 2335.
This project lab is an introduction to the analytical techniques and physical and chemical methods useful in modern ecological studies.

BIOL 4570. Immunology and Immunochemistry
3-0-3. Prerequisite(s): BIOL 3331 and BIOL 2334.
A survey modern immunology and its applications.

BIOL 4571. Immunochemistry Laboratory
0-3-1. Co-requisite: BIOL 4570.
Laboratory techniques in immunology and immunochemistry.

BIOL 4755. Mathematical Biology
3-0-3. Prerequisite(s): MATH 1502 and CS 1301 and BIOL 3332.
An introduction to practical applications of mathematical models to help unravel the underlying mechanisms involved in biological processes. Crosslisted with MATH 4755.

BIOL 4801,-2,-3,-4,-5. Special Topics
Credit and class hours equal last digit of course number.
This designation enables the School of Biology to provide new lecture courses dealing with areas of current interest in biological science.

BIOL 4901,-2,-3,-4,-5. Special Problems
Credit hours to be arranged.
Research problem in biology under supervision of a faculty member. To be offered any semester with credit to be arranged. Seven hours is maximum allowed for technical elective credit.

BIOL 6608. Prokaryotic Molecular Genetics
3-0-3. Prerequisite(s): BIOL 2334.
Genetics of bacteria, plasmids, and viruses. Organization and regulation of expression of genetic material, with emphasis on techniques and current mechanisms of nucleic acid metabolism.

BIOL 6611. Advanced Microbial Physiology
3-0-3. Prerequisite(s): BIOL 4418 and CHEM 4511.
Advanced studies of selected aspects of the physiology of prokaryotic and eukaryotic microorganisms.

BIOL 6612. Advanced Bacterial Metabolism
3-0-3. Prerequisite(s): BIOL 6611
A study of microbial chemistry with emphasis on catabolic events.

BIOL 6626. Physiological Ecology
3-0-3. Prerequisite(s): BIOL 4010.
Study of the basic physiological processes and systems in vertebrates and invertebrates. Comparative study on how these systems are adapted for specific environments and functions.

BIOL 6628. Aquatic Toxicology
3-0-3. Prerequisite(s): BIOL 4010.
Study of the biological effects of toxicants on aquatic organisms-mechanisms of toxicity, biotransformation, toxicity tests, ecological risk assessment.

BIOL 6630. Advanced Microbial Ecology
3-0-3. Prerequisite(s): BIOL 4410.
Advanced studies of selected aspects of the ecology of prokaryotic and eukaryotic organisms.

BIOL 6765. Geomicrobiology
3-0-3. Prerequisite(s): EAS 3311 and (BIOL 4410 or BIOL 4418).
Interactions between microorganisms and the geosphere, microbial energetics and genetics; geochemical controls on microbial diversity and activity. Crosslisted with EAS 6765.

BIOL 7000. Master's Thesis
Credit hours to be arranged.

BIOL 7010. Advanced Cell Biology
3-0-3. Prerequisite(s): BIOL 3331
Current topics in eukaryotic cell biology including membrane functions, intracellular sorting and compartmentalization, cell signaling, cell cycle, cytoskeleton, cell adhesion, motility, and current experimental approaches.

BIOL 7020. Bioinformatics
3-0-3.
Introduction into computer methods of DNA and protein sequence analysis. Finding genes and protein function prediction. Constructing evolutionary trees.

BIOL 7101. Advanced Sensory Ecology
3-0-3.
A quantitative analysis of how organisms of all kinds obtain information about their environment, and how they use it to guide locomotions.

BIOL 7668. Eukaryotic Molecular Genetics
3-0-3.
Topics in molecular genetics of eukaryotic organisms, including: gene structure and expression, protein processing and folding, genome stability and molecular evolution.

BIOL 7670. Advances in Biomolecular Separation Techniques
3-0-3.
Introduction to modern biomolecular separation methods. Topics include theory of chromatography, discussion of chromatography and electrophoretic techniques for protein, nucleic acid separations and other biological substances.

BIOL 8001. Seminar
2-0-2.
Presentation of research seminar.

BIOL 8002,-3. Seminar
1-0-1, each.
Weekly seminars on current research presented by various scientists in the field of biology.

BIOL 8013,-4. Seminar in Microbiology
2-0-2, each.
Topics of current interest in microbial physiology, applied microbiology, microbial ecology, and medical microbiology.

BIOL 8023,-4. Seminar in Ecology
2-0-2, each.
Topics of current interest in the general areas of population growth and limitation, and the structure and stability of ecosystems.

BIOL 8063,-4. Seminar in Molecular Biology
2-0-2, each.
Topics of current interest in the area of molecular biology.

BIOL 8101. Introduction to Research, Biology Instrumentation, and Safety
2-0-2.
Introduction to biology faculty research, explanation, and demonstration of biology instrumentation and laboratory safety.

BIOL 8801,-2,-3,-4,-5. Special Topics
Credit and class hours equal last digit of course number.
New graduate lecture courses in areas of current interest.

BIOL 8901,-2. Special Problems
Credit hours to be arranged.
Research problems in biology under the supervision of a faculty member.

BIOL 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding teaching aassistantships.

BIOL 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding research assistantships.

BIOL 9000. Doctoral Thesis
Credit hours to be arranged.

School of Chemistry and Biochemistry

Established in 1906
Location: Boggs Chemistry Building
Telephone: (404) 894-4002
Fax: (404) 894-7452
Website: www.chemistry.gatech.edu

Chair and Professor–Laren M. Tolbert; *Associate Chair and Professor*–Raymond F. Borkman; *Director of Graduate Studies and Associate Professor*–David M. Collard; *Director of Undergraduate Studies and Professor*–Thomas F. Moran; *Institute and Regents' Professor*–Leon H. Zalkow; *Vice Provost and Dean of Graduate Studies and Regents' Professor*–Charles L. Liotta; *Regents' Professors*–Richard F. Browner, Sheldon W. May, James C. Powers; *Dean of the College of Sciences and Professor*–Gary B. Schuster; *Associate Dean and Professor*–E. Kent Barefield; *Julius Brown Chair and Professor*–Mostafa A. El-Sayed; *Eminent Scholar and Professor*–Jiri (Art) Janata; *Professors*–Lawrence A. Bottomley, Edward M. Burgess, Kenneth L. Busch, Sidney L. Gordon, William S. Rees Jr., Robert L. Whetten, Paul H. Wine; *Associate Professors*–Richard A. Ikeda, Loren D. Williams; *Assistant Professors*–Robert M. Dickson, Christoph J. Fahrni, Rigoberto Hernandez, Nicholas V. Hud, L. Andrew Lyon, Stephen Quirk, Katherine L. Seley, Suzanne B. Shuker, Angus P. Wilkinson, Z. John Zhang; *Adjunct Faculty*–Haskell W. Beckham, Charles A. Eckert, Robert E. Schwerzel; *Academic Advisor*–J. Cameron Tyson; *Laboratory Coordinators*–Toby F.Block, Robert A. Braga.

General Information

The School offers courses in chemistry required for various engineering and science curricula, as well as for students interested in medical school, for the degree Bachelor of Science in Chemistry and for graduate work leading to the degrees Master of Science in Chemistry and Doctor of Philosophy in Chemistry.

Undergraduate Program

The Bachelor of Science in Chemistry degree program consists of a combination of requirements and electives that ensure a strong foundation in physical, inorganic, organic, and analytical chemistry while providing the flexibility to tailor the curriculum to satisfy specific interests or career goals. Biochemistry, Polymers, and Materials Options are available for students who wish to include these fields as substantial components of their program. Students who wish to prepare for the Georgia Teaching Certificate (T-4) may do so by taking the necessary teacher education courses. The judicious use of free electives also enables the student to achieve considerable knowledge of other disciplines at Georgia Tech such as chemical engineering, materials engineering, computing, physics, mathematics, management, textiles, and biology. The chemistry curriculum options enable majors who are interested in medical or dental schools to meet admission requirements of these schools.

Certificate Programs

The School of Chemistry and Biochemistry offers, for non-chemistry majors, programs of study leading to certificates in three areas; biochemistry/organic chemistry, chemical analysis, and physical/inorganic chemistry. These certificate programs should be of interest to students considering careers in medicine or chemical-related industries, as well as those who wish to strengthen their background in areas of chemistry that are not required by their major.

Each certificate program requires a minimum of 12 hours in a coherent program with at least 9 hours at the 3000 level or higher. These courses must be chosen from the list of courses in the given emphasis area and must be completed with a grade of *C* or better. Courses required by the student's major may not be used in the certificate program. Courses which may be taken to satisfy the certificate requirements are as follows:

Biochemistry/Organic Chemistry Certificate - CHEM 2312, 2313, 2380, 3511, 4311, 4341, 4511, 4512, 4582
Chemical Analysis Certificate - CHEM 2380, 3211, 3411, 3412, 4341, 4401
Physical/Inorganic Chemistry Certificate - CHEM 2380, 3111, 3380, 3411, 3412, 3481, 4452

Additional information regarding undergraduate programs is available by writing to the director of Undergraduate Studies, School of Chemistry and Biochemistry, Georgia Institute of Technology, Atlanta, Georgia 30332-0400.

Bachelor of Science in Chemistry (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
CHEM 1211	GENERAL CHEMISTRY	4
CS 1301	COMPUTER SCIENCE I	3
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS		16

First Year - Spring Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
BIOL 1510	BIOL. PRINCIPLES	4
CHEM 1311	INORGANIC CHEMISTRY I	3
CHEM 1313	QUANTITATIVE METHODS	3
TOTAL SEMESTER HOURS		17

Second Year - Fall Semester

Course Number/Name		*Hours*
CHEM 2311	ORGANIC CHEM. I	3
MATH 2401	CALCULUS III	4
PHYS 2211	PHYSICS I	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		17

Second Year - Spring Semester

Course Number/Name		*Hours*
CHEM 2312	ORGANIC CHEMISTRY II	3
CHEM 2380	SYNTHESIS LAB I	2
PHYS 2212	PHYSICS II	4
SOCIAL SCIENCE ELECTIVE		3
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		15

Third Year - Fall Semester

Course Number/Name		*Hours*
CHEM 3411	PHYSICAL CHEM. I	3
CHEM 3111	INORGANIC CHEM. II	3
CHEM 3380	SYNTHESIS LAB II	3
SOCIAL SCIENCE ELECTIVE		3
FREE ELECTIVE		3
TOTAL SEMESTER HOURS		15

Third Year - Spring Semester

Course Number/Name		*Hours*
CHEM 3412	PHYSICAL CHEM. II	3
CHEM 3481	PHYSICAL CHEM. LAB	2
CHEM 3211	ANALYTICAL CHEMISTRY	5
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		13

Fourth Year - Fall Semester

Course Number/Name		*Hours*
CHEM 4681	ADV. CHEM. LAB	5
CHEM 3511 or 4511 or 4512		3
CHEM ELECTIVE		3
TECHNICAL ELECTIVE		3
TOTAL SEMESTER HOURS		14

Fourth Year - Spring Semester

Course Number/Name		*Hours*
CHEM ELECTIVE		3
TECHNICAL ELECTIVE		3
FREE ELECTIVES		9
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Electives

Social Sciences Electives

See "Information for Undergraduates" for information relative to the Institute requirement of 12 hours of humanities and 12 hours of social sciences (pages 33-34). All students must satisfy state requirements regarding course work in the history and constitutions of the United States and Georgia. HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200 fulfill these requirements.

Chemistry Electives

Chemistry electives include CHEM 3482 and all CHEM 4000-level courses except CHEM 4681, specifically required biochemistry courses, and CHEM 4901-3.

Technical Electives

The technical elective requirement may be fulfilled by courses in science, engineering, and computing at the 3000 level or higher. A maximum of three hours toward the technical elective requirement may be chosen from CHEM 4901-3.

Biochemistry Option

Students who wish to prepare for careers that require proficiency in biochemistry may do so by choosing the Biochemistry Option under the Bachelor of Science in Chemistry curriculum. This option may be of interest to students who plan careers in medicine, teaching, or research, as well as those who wish to broaden their curriculum by including courses in this rapidly growing field.

Bachelor of Science in Chemistry - Biochemistry Option (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
CHEM 1211	GENERAL CHEMISTRY	4
CS 1301	COMPUTER SCIENCE I	3
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS		16

First Year - Spring Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
BIOL 1510	BIOL. PRINCIPLES	4
CHEM 1311	INORGANIC CHEM. I	3
CHEM 1313	QUANTITATIVE METHODS	3
TOTAL SEMESTER HOURS		17

Second Year - Fall Semester

Course Number/Name		*Hours*
CHEM 2311	ORGANIC CHEM. I	3
MATH 2401	CALCULUS III	4
PHYS 2211	PHYSICS I	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		17

Second Year - Spring Semester

Course Number/Name		*Hours*
CHEM 2312	ORGANIC CHEM. II	3
CHEM 2380	SYNTHESIS LAB I	2
PHYS 2212	PHYSICS II	4
SOCIAL SCIENCE ELECTIVE		3
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		15

Third Year - Fall Semester

Course Number/Name		*Hours*
CHEM 3411	PHYSICAL CHEM. I	3
CHEM 3111	INORGANIC CHEM. II	3
CHEM 3380	SYNTHESIS LAB II	3
CHEM 4511	BIOCHEM. I	3
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		15

Third Year - Spring Semester

Course Number/Name		*Hours*
CHEM 3412	PHYSICAL CHEM. II	3
CHEM 3481	PHYSICAL CHEM. LAB	2
CHEM 4512	BIOCHEM. II	3
CHEM 4581	BIOCHEM LAB I	3
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		14

Fourth Year - Fall Semester

Course Number/Name		*Hours*
BIOCHEMISTRY ELECTIVE		4
CHEM 4601	CHEM. SEMINAR	2
FREE ELECTIVES		7
TOTAL SEMESTER HOURS		13

Fourth Year - Spring Semester

Course Number/Name		*Hours*
BIOCHEMISTRY ELECTIVE		3
CHEM 3211	ANALYTICAL CHEMISTRY	5
FREE ELECTIVES		7
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Biochemistry Electives

At least one of the biochemistry electives chosen must contain a laboratory component. The biochemistry electives are: CHEM 4521, 4582, and biology courses BIOL 3410, 3420, 3430, 3450, 3510, 4220, 4230, 4240, 4250, 4290, 4320, 4340, 4460.

Polymers and Materials Options

Students who wish to prepare for careers where a knowledge of polymers and/or materials would be beneficial may do so by choosing the Polymers Option or the Materials Option under the Bachelor of Science in Chemistry curriculum. These options may be of interest to students who plan careers in industry, teaching, or research, as well as those who wish to broaden their curriculum by including these important fields.

Bachelor of Science in Chemistry - Polymers Option (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
CHEM 1211	GENERAL CHEMISTRY	4
CS 1301	COMPUTER SCIENCE I	3
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS		16

First Year - Spring Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
BIOL 1510	BIOL. PRINCIPLES	4
CHEM 1311	INORGANIC CHEM. I	3
CHEM 1313	QUANTITATIVE METHODS	3
TOTAL SEMESTER HOURS		17

Second Year - Fall Semester

Course Number/Name		*Hours*
CHEM 2311	ORGANIC CHEMISTRY I	3
MATH 2401	CALCULUS III	4
PHYS 2211	PHYSICS I	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		17

Second Year - Spring Semester

Course Number/Name		*Hours*
CHEM 2312	ORGANIC CHEM. II	3
CHEM 2380	SYNTHESIS LAB I	2
PHYS 2212	PHYSICS II	4
SOCIAL SCIENCE ELECTIVE		3
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		15

Third Year - Fall Semester

Course Number/Name		*Hours*
CHEM 3411	PHYSICAL CHEMISTRY I	3
CHEM 3111	INORGANIC CHEMISTRY II	3
CHEM 3380	SYNTHESIS LAB II	3
SOCIAL SCIENCE ELECTIVE		3
FREE ELECTIVE		3
TOTAL SEMESTER HOURS		15

Third Year - Spring Semester

Course Number/Name		*Hours*
CHEM 3412	PHYSICAL CHEMISTRY II	3
CHEM 3481	PHYSICAL CHEMISTRY LAB I	2
CHEM 3211	ANALYTICAL CHEMISTRY	5
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		13

Fourth Year - Fall Semester

Course Number/Name		*Hours*
CHEM 4681	ADV. CHEM. LAB	5
CHEM 3511 or 4511 or 4512		3
CHEM 4775	POLYMER SCIENCE I	3
POLYMER ELECTIVE		3
TOTAL SEMESTER HOURS		14

Fourth Year - Spring Semester

Course Number/Name		*Hours*
CHEMISTRY ELECTIVE		3
CHEM 4776	POLYMER SCIENCE II	3
FREE ELECTIVES		9
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS).

Polymer Electives

The polymer elective may be fulfilled by polymer courses in science and engineering at the 3000 level or higher.

Bachelor of Science in Chemistry - Materials Option (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
CHEM 1211	GENERAL CHEMISTRY	4
CS 1301	COMPUTER SCIENCE I	3
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS		16

First Year - Spring Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
BIOL 1510	BIOL. PRINCIPLES	4
CHEM 1311	INORGANIC CHEM. I	3
CHEM 1313	QUANTITATIVE METHODS	3
TOTAL SEMESTER HOURS		17

Second Year - Fall Semester

Course Number/Name		*Hours*
CHEM 2311	ORGANIC CHEMISTRY I	3
MATH 2401	CALCULUS III	4
PHYS 2211	PHYSICS I	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		17

Second Year - Spring Semester

Course Number/Name		*Hours*
CHEM 2312	ORGANIC CHEM. II	3
CHEM 2380	SYNTHESIS LAB I	2
PHYS 2212	PHYSICS II	4
SOCIAL SCIENCE ELECTIVE		3
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		15

Third Year - Fall Semester

Course Number/Name		*Hours*
CHEM 3411	PHYSICAL CHEM. I	3
CHEM 3111	INORGANIC CHEM. II	3
CHEM 3380	SYNTHESIS LAB II	3
MSE 2001	PRINC. & APPS. OF ENG. MATERIALS	3
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		15

Third Year - Spring Semester

Course Number/Name		*Hours*
CHEM 3412	PHYSICAL CHEMISTRY II	3
CHEM 3481	PHYSICAL CHEM. LAB I	2
CHEM 3211	ANALYTICAL CHEMISTRY	5
MSE 3001	THERMO. OF MATERIALS	3
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		16

Fourth Year - Fall Semester

Course Number/Name		*Hours*
CHEM 4681	ADV. CHEMISTRY LAB	5
CHEM 3511 or 4511 or 4512		3
MSE 3010	CRYSTALLOGRAPHY AND DIFFRACTION	3
FREE ELECTIVES		3
TOTAL SEMESTER HOURS		14

Fourth Year - Spring Semester

Course Number/Name		*Hours*
MSE 3020	MATERIALS LAB	3
FREE ELECTIVES		9
TOTAL SEMESTER HOURS		12

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Graduate Programs

The School of Chemistry and Biochemistry offers programs for the doctoral and master's degrees in the fields of analytical, biochemistry, inorganic, organic, physical, and polymer chemistry.

The goal of the doctoral program is to provide proficient knowledge in a specialized area of chemistry, with particular emphasis being placed on original, independent, and scholarly research. Students working toward a Ph.D. must complete 12 credit hours of courses in their major area (analytical, biochemistry, inorganic, organic, physical or polymers) and 9 credit hours in a minor (which might include seminar courses and courses outside of the department). Students should complete all course requirements in the first year of graduate study and present a seminar in the second year. The Ph.D. candidacy examination consists of a series of examinations in the major area based on a reading assignment from the recent literature and an original research proposal to be completed by the end of the second year. Independent research for the Ph.D. is demonstrated by completion of published work.

Two different programs of study leading to a master's degree are offered by the School of Chemistry and Biochemistry. The formal requirements for the M.S. degree (thesis option) are 24 credit hours of approved course work beyond the bachelor's degree, along with an approved M.S. thesis. The formal requirement for the M.S. degree (nonthesis option) is 30 credit hours of approved course work beyond the bachelor's degree. The M.S. degree (nonthesis option) is a terminal degree in this department. Active research fields include: Biomolecular Structure, Molecular Biology, and Biophysics; Computational and Theoretical Chemistry; Inorganic and Materials Chemistry; Nanochemistry; Pharmaceutical and Bio-organic Chemistry; Photochemistry, Photobiology, and Excited State Dynamics; Polymer Chemistry; and Sensors, Environmental, and Analytical Chemistry.

Financial Aid

Financial support is available for graduate study in the School of Chemistry and Biochemistry. The usual form of financial aid for first-year students is the teaching assistantship. Most students beyond the first year are appointed as research assistants. Both teaching and research assistants receive full tuition waivers.

Additional information on the graduate program is available by writing the Graduate Coordinator, School of Chemistry and Biochemistry, Georgia Institute of Technology, Atlanta, GA 30332-0400, or via the web: www.chemistry.gatech.edu

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

CHEMISTRY

Note: All students are required to wear safety glasses while working in the laboratories. The glasses will be provided at the student's expense.

CHEM 1211. General Chemistry
3-3-4.
Fundamental laws and theories of chemical reactions. Topics include atomic structure, bonding theory, stoichiometry, properties of solids, liquids and gases, chemical thermodynamics, electrochemistry, and kinetics.

CHEM 1311. Inorganic Chemistry I
3-0-3. Prerequisite(s): CHEM 1211 and (CHEM 1312 or CHEM 1313).
A continuation of CHEM 1211. Topics include chemical equilibrium, acids, bases, descriptive inorganic chemistry and materials, introduction to organic chemistry.

CHEM 1312. Inorganic Chemistry Lab I
0-3-1. Prerequisite(s): CHEM 1211; Co-requisite: CHEM 1311.
Laboratory to accompany Inorganic Chemistry I. Topics include qualitative and quantitative analysis of inorganic and organic compounds.

CHEM 1313. Quantitative Analysis
2-4-3. Prerequisite(s): CHEM 1211; Co-requisite: CHEM 1311.
Laboratory experimentation emphasizing quantitative chemical analysis.

CHEM 2311. Organic Chemistry I
3-0-3. Prerequisite(s): CHEM 1311.
An introduction to structure and reactivity of organic molecules.

CHEM 2312. Organic Chemistry II
3-0-3. Prerequisite(s): CHEM 2311.
The second course in the series dealing with the structure and reactivity of organic molecules.

CHEM 2313. Organic and Bioorganic Chemistry
3-0-3. Prerequisite(s): CHEM 2311.
A second course in organic chemistry which extends the study to topics in biochemistry.

CHEM 2380. Synthesis Laboratory I
1-4-2. Prerequisite(s): CHEM 2311 and (CHEM 1312 or CHEM 1313) and (CHEM 2312 or CHEM 2313).
Methods for preparation, isolation, and characterization of complex organic molecules, natural products, and polymers.

CHEM 2801,-2,-3. Special Topics
Credit and hours equal last digit of course number. Prerequisite(s): CHEM 1311.
Lecture course in current special topics in chemistry and biochemistry. Topics will vary from year to year.

CHEM 2901,-2,-3. Special Problems in Chemistry
Credit hours to be arranged. Prerequisite(s): CHEM 1311.
Course of individual instruction, which will include library conference and laboratory experience.

CHEM 3111. Inorganic Chemistry II
3-0-3. Prerequisite(s): CHEM 1311.
A study of the reactions and structures of inorganic compounds and principles, generalizations and theories that assist in understanding their behavior.

CHEM 3211. Analytical Chemistry
3-5-5. Prerequisite(s): CHEM 1313; Co-requisite: CHEM 3412.
Introduction to the theory and practice of modern chemical analysis.

CHEM 3281. Instrumental Analysis for Engineers
3-3-4. Prerequisite(s): CHEM 2380 and CHEM 3412.
Provides a background to modern analytical chemistry and instrumental methods of analysis with applications to engineering and other areas.

CHEM 3371. Organic Chemistry Laboratory
1-4-2. Prerequisite(s): CHEM 2380 and (CHEM 2312 or CHEM 2313).
Multistep organic synthesis and inorganic synthesis. Use of chemical literature and advanced spectroscopic techniques.

CHEM 3380. Synthesis Laboratory II
1-6-3. Prerequisite(s): CHEM 2380; Co-requisite: CHEM 3111.
Multistep organic and inorganic synthesis. Use of chemical literature and advanced spectroscopic techniques.

CHEM 3411. Physical Chemistry I
3-0-3. Prerequisite(s): CHEM 1311
Chemical thermodynamics, energetics of chemical reactions, changes of state, and electrochemistry.

CHEM 3412. Physical Chemistry II
3-0-3. Prerequisite(s): CHEM 1311 and PHYS 2212.
Quantum mechanics, atomic and molecular structure, bonding theory, molecular spectroscopy, statistical mechanics.

CHEM 3481. Physical Chemistry Laboratory I
0-6-2. Prerequisite(s): CHEM 3411 or (CHE 2200 and CHEM 3411); Co-requisite: CHEM 3412.
Laboratory investigations of physical principles applied to chemical systems.

CHEM 3482. Physical Chemistry Laboratory II
0-6-2. Prerequisite(s): CHEM 3481.
Laboratory investigations of physical principles applied to chemical systems.

CHEM 3511. Survey of Biochemistry
3-0-3. Prerequisite(s): CHEM 2312.
Introductory course in biochemistry dealing with the chemistry and biochemistry of proteins, lipids, carbohydrates, nucleic acids, and other biomolecules.

CHEM 4311. Advanced Organic Chemistry
3-0-3. Prerequisite(s): CHEM 2312.
Construction reactions and functional group interconversions as applied to multistep organic synthesis.

CHEM 4341. Applied Spectroscopy
3-0-3. Prerequisite(s): CHEM 2312
Theory and application of NMR, mass spectrometry, and infrared spectroscopy in the determination of organic structures.

CHEM 4401. Molecular Spectroscopy
3-0-3. Prerequisite(s): CHEM 3412.
Introduction to the theory and applications of molecular spectroscopy, including electronic, vibrational, rotational transitions, and selections rules.

CHEM 4452. Chemistry of the Solid State
3-0-3. Prerequisite(s): CHEM 3111 and CHEM 3412.
Application of the concepts of physical and inorganic chemistry to the structure of solids and their chemical and physical properties.

CHEM 4511-2. Biochemistry I,-II
3-0-3, each. Prerequisite(s): CHEM 2312.
The chemistry and biochemistry of proteins, lipids, carbohydrates, nucleic acids, and other biomolecules.

CHEM 4521. Biophysical Chemistry
3-0-3. Prerequisite(s): CHEM 3412 and CHEM 4511.
The physical chemistry of biological systems, biological macromolecules, and biological aggregates.

CHEM 4581. Biochemistry Laboratory I
1-6-3. Prerequisite(s): (CHEM 3511 or CHEM 4511) and (CHEM 3371 or CHEM 3380).
Modern biochemical techniques including methods for protein, nucleic acid, and lipid isolation and characterization, enzyme assays, chromatography, electrophoresis, and use of databases.

CHEM 4582. Biochemistry Laboratory II
1-6-3. Prerequisite(s): CHEM 4512 and CHEM 4581; Co-requisite: CHEM 4521
Laboratory techniques in the isolation and characterization of biological molecules with special emphasis on modern techniques.

CHEM 4601. Chemistry Seminar
2-0-2.
Student presentations of recent research topics in chemistry or biochemistry based on lab experience and/or literature searches.

CHEM 4681. Advanced Chemistry Laboratory
1-10-5. Prerequisite(s): CHEM 3380 and CHEM 3481.
A molecular laboratory involving a series of multipart experiments that build upon chemical principles and experimental techniques introduced in earlier courses and instructional laboratories.

CHEM 4775. Polymer Science and Engineering I: Formation and Properties
3-0-3. Prerequisite(s): CHEM 2312 and CHEM 3411.
An introduction to the chemistry, structure, and formation of polymers, physical states, and transitions; physical and mechanical properties of polymer fluids and solids. Crosslisted with CHE, ME, MSE, and TFE 4775.

CHEM 4776. Polymer Science and Engineering II: Analysis, Processing, and Laboratory
1-6-3. Prerequisite(s): CHE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or TFE 4775.
Polymer fabrication processes and methods of characterization and identification of polymers are presented. Experiments in polymerization, processing, and property evaluation of polymers. Crosslisted with CHE, ME, MSE and TFE 4776.

CHEM 4901,-2,-3. Special Problems in Chemistry
Credit hours to be arranged.
Course of individualized instruction, which will include library, conference, and laboratory investigations.

CHEM 6170. Inorganic Chemistry I
3-0-3.
A series of key topics in inorganic chemistry will be reviewed: acids/bases, redox processes, bonding and structure, transition metal chemistry, coordination complexes.

CHEM 6171. Inorganic Chemistry II
3-0-3.
Contemporary topics in inorganic chemistry including bioinorganic chemistry, reaction mechanisms and kinetics, optical and magnetic properties of molecular species, and inorganic materials.

CHEM 6172. Physical Methods in Inorganic Chemistry
3-0-3.
An introduction to the use of physical methods in inorganic chemistry including, vibrational spectroscopy, multinuclear NMR, EST, Mossbauer, magnetometery, NQR, PES, diffraction, and EXAFS.

CHEM 6181. Chemical Crystallography
3-0-3.
The collection and interpretation of diffraction data. Single crystal structure analysis, powder diffraction for phase identification and quantitative analysis, and Rietveld refinement.

CHEM 6182. Chemistry of the Solid State
3-0-3.
An introduction to the chemistry of the solid state. Synthetic methods, measurement of properties, structure of solids, theory of electrical, optical, and magnetic properties.

CHEM 6183. Organometallic Chemistry
3-0-3.
The chemistry of main group and transition metal organometallics. Including synthetic methods, homogeneous catalysis and catalytic cycles, and synthetically useful organometallic reagents.

CHEM 6271. Analytical Chemistry I
3-0-3.
Discussion of chemical equilibrium, separations, and bioanalytical methods.

CHEM 6272. Analytical Chemistry II
3-0-3. Prerequisite(s): CHEM 6271.
Topics include experimental design, electronics, and spectroscopy.

CHEM 6281. Mass Spectrometry
3-0-3.
Topics include sample handling, ionization methods, MS/MS, and quantitative analysis.

CHEM 6282. Chemical Sensors
3-0-3.
Origins of selectivity, principles of transduction mechanisms, construction and applications of modern chemical sensors.

CHEM 6283. Electroanalytical Chemistry
3-0-3.
Coulometry, electrolytic separations, polargraphy, chronopotentiometry, coulometric titrations, voltammetry, and hydrodynamic electrochemical methods of analysis.

CHEM 6284. Environmental Analytical Chemistry
3-0-3.
Application of techniques from analytical chemistry in monitoring the environment.

CHEM 6285. Analytical Spectroscopy
3-0-3.
Modern analytical spectroscopy and use of analytical techniques in chemistry and chemical engineering.

CHEM 6371. Identification of Organic Compounds
3-0-3.
Description of molecular structure and identification of organic compounds using spectroscopic techniques.

CHEM 6372. Physical Organic Chemistry
3-0-3.
Physical methods in organic chemistry; determination of reaction pathways.

CHEM 6373. Organic Synthesis
3-0-3. Prerequisite(s): CHEM 6372.
Methods and strategy for the preparation of complex organic compounds.

CHEM 6381. Advanced Organic Synthesis
3-0-3. Prerequisite(s): CHEM 6373.
Advanced topics in the synthesis of complex organic molecules.

CHEM 6382. Computational Methods in Organic Chemistry and Biochemistry
2-0-3. Prerequisite(s): CHEM 6372.
The development of approximate methods in molecular orbital theory and molecular mechanics and their application to problems in organic and biochemistry.

CHEM 6471. Chemical Thermodynamics and Kinetics
3-0-3.
Laws of classical thermodynamics and their chemical application. Introduction to statistical mechancis and chemical kinetics.

CHEM 6472. Quantum Chemistry and Molecular Spectroscopy
3-0-3.
Introduction to quantum mechanics and its application to molecular systems, atomic and molecular spectroscopy.

CHEM 6481. Statistical Mechanics
3-0-3. Prerequisite(s): CHEM 6471.
Statistical thermodynamics, lattice statistics, molecular distribution and correlation functions, the theories of liquids and solutions, phase transitions, cluster theory, and measurement.

CHEM 6482. Chemical Kinetics and Reaction Dynamics
3-0-3.
Modern theoretical and experimental methods for studying macroscopic and microscopic bimolecular and unimolecular processes are discussed, as are methods for describing complex kinetic systems.

CHEM 6491. Quantum Mechanics
3-0-3. Prerequisite(s): CHEM 6472.
Important concepts and applications of quantum mechanics at the intermediate level, including operators, perturbation and variational methods applied to atoms and molecules.

CHEM 6492. Molecular Spectroscopy
3-0-3. Prerequisite(s): CHEM 6491.
Study of energy of electronic transitions in molecules, selection rules, excitation processes, and laser spectroscopy.

CHEM 6501. Biochemistry I
3-0-3.
The chemistry and biochemistry of proteins, lipids, carbohydrates, nucleic acids, and other biomolecules.

CHEM 6502. Biochemistry II
3-0-3.
The chemistry and biochemistry of proteins, lipids, carbohydrates, nucleic acids, and other biomolecules.

CHEM 6571. Enzymology
3-0-3. Prerequisite(s): CHEM 6501 and CHEM 6502.
Structure and chemistry of enzymes, enzyme mechanism, enzyme kinetics, enzyme inhibitors, and medicinal chemistry.

CHEM 6572. Macromolecular Structure
3-0-3. Prerequisite(s): CHEM 6501 and CHEM 6502.
Principles of protein, nucleic acid, and membrane structure. Major emphasis on protein folding, detailed description of three-dimensional structure of proteins and nucleic acids.

CHEM 6573. Molecular Biochemistry
3-0-3. Prerequisite(s): CHEM 6501 and CHEM 6502.
Current topics in molecular biology including eukaryotic transcriptions, RNA processing, repair and recombination, immunity, viruses, DNA fingerprinting, and genome sequencing.

CHEM 6581. Protein Crystallography
3-0-3. Prerequisite(s): CHEM 6181.
Application of crystallographic principles to the structure determination of macromolecules by molecular replacement, multiple isomorphous replacements. High-speed data collection methods and cryocrystallography.

CHEM 6582. Biophysical Chemistry
3-0-3.
Applications of the principles and techniques of physical chemistry in biochemistry, with emphasis in the equilibrium and dynamic behavior of macromolecules in solution.

CHEM 6583. Drug Design and Discovery
3-0-3. Prerequisite(s): CHEM 3312 and CHEM 4512.
Application of principles of chemistry and biology to the creation of knowledge leading to the introduction of new therapeutic agents.

CHEM 6584. Contemporary Biochemistry
3-0-3. Prerequisite(s): CHEM 6501 and CHEM 6502.
Topics vary from year to year, but will include subjects from the biochemical literature, such as in *J. Biological Chemistry*.

CHEM 6750. Preparation and Reaction of Polymers
3-0-3. Prerequisite(s): CHEM 4775 or CHE 4775 or ME 4775 or MSE 4775 or TFE 4775.
A detailed treatment of the reactions involved in the synthesis of both human-made and natural polymers, including preparation and degradative reactions of polymer systems. Crosslisted with CHE and TFE 6750.

CHEM 6751. Physical Chemistry of Polymer Solutions
3-0-3. Prerequisite(s): (CHE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or TFE 4775) or (ME 4777 or MSE 4777 or TFE 4777).
Study of polymer solutions, polymer miscibility, absorptions, sorptions, plasticization, molecular weights, molecular weight distributions, and interfacial phenomena using thermodynamics and statistical mechanics. Crosslisted with CHE, MSE and TFE 6751.

CHEM 6752. Polymer Characterization
3-3-4. Prerequisite(s): (CHE 4775 or CHEM 4775 or ME 4775 or MSE 4775 or TFE 4775) or (ME 4777 or MSE 4777 or TFE 4777)
This course introduces the student to surface, near-surface, and structural methods of polymer characterization. Specialized techniques critical to physical structure are emphasized. Crosslisted with CHE, MSE, and TFE 6752.

CHEM 6755. Theoretical Chemistry of Polymers
3-0-3. Prerequisite(s): CHEM 6471 and (CHE 6751 or CHEM 6751 or MSE 6751 or TFE 6751).
Thermodynamics and microscopic dynamics of polymers. Fundamental concepts, including scaling concepts, governing anisotropy of polarizability, phase transitions, morphology, time-dependent correlations, etc. are discussed. Crosslisted with MSE and TFE 6755.

CHEM 7000. Master's Thesis
Credit hours to be arranged.

CHEM 7001. Introduction to Research
1-6-3.
Introduction to laboratory techniques, experimental design, library and database searching, presentations.

CHEM 8000. Seminar in Chemistry
1-0-1.

CHEM 8001. Faculty Seminar
2-0-2.

CHEM 8002. Information Resources for Chemists and Biochemists
2-0-2.

CHEM 8003. Student Seminar
2-0-2.

CHEM 8810. Special Topics in Inorganic Chemistry
3-0-3.
Topics from the inorganic chemistry research literature.

CHEM 8820. Special Topics in Analytical Chemistry
3-0-3.
Topics from the analytical chemistry research literature.

CHEM 8830. Special Topics in Organic Chemistry
3-0-3.
Topics from the organic chemistry research literature.

CHEM 8840. Special Topics in Physical Chemistry
3-0-3.
Topics from the physical chemistry research literature.

CHEM 8850. Special Topics in Biochemistry
3-0-3.
Topics from the biochemistry research literature.

CHEM 8870. Special Topics in Polymer Chemistry
3-0-3.
Topics from the polymer research literature.

CHEM 8901,-2,-3. Special Problems
Credit hours to be arranged.

CHEM 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding graduate teaching assistantships.

CHEM 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding graduate research assistantships.

CHEM 9000. Doctoral Thesis
Credit hours to be arranged.

School of Earth and Atmospheric Sciences

Established in 1970
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Telephone: (404) 894-3893
Website: www.eas.gatech.edu
E-mail: ugradcor@eas.gatech.edu (undergraduate coordinator); gradcor@eas.gatech.edu (graduate coordinator)

Acting Chair and Professor–Derek M. Cunnold; *Graduate Coordinator and Professor*–Robert P. Lowell; *Undergraduate Coordinator and Professor*–Robert G. Roper; *Regents' Professor and Smithgall Chair*–William L. Chameides; *Georgia Research Alliance Eminent Scholar and Professor*–Shaw Liu; *Institute Professor*–Chia Szu (C.S.) Kiang; *Professors*–George Chimonas, Douglas D. Davis, Philip N. Froelich, L. Timothy Long, E. Michael Perdue, Charles E. Weaver (emeritus), Paul Wine; *Associate Professors*–Patricia M. Dove, L. Gregory Huey, J. Marion Wampler; *Assistant Professors*–Michael H. Bergin, James B. Gaherty, A. Hope Jahren, Daniel Lizzaralde, Carolyn D. Ruppel, Rodney J. Weber; *Principal Research Scientist*–Fred L. Eisele; *Senior Research Scientists*–Scott Sandholm, Rick Saylor; *Research Scientists II*–Robert X. Black, Carlos A. Cardelino, Gao Chen, Mian Chin, Hann-Wen Guan, Stagg King, Billy Murphey, Erik Richard, James C. St. John, Hsiang-Jui Wang, Yuhang Wang; *Adjunct Professors*–Jack O. Blanton, Donald Canfield, Paul Crutzen, Thomas F. Gross, Richard Jahnke, Leonard Newman, Stuart Wakeham, Herbert L. Windom; *Adjunct Associate Professors*–Clark R. Alexander, Albin Gasiewski, Carmen Nappo, John C. Nemeth, Shahrokh Rouhani; *Adjunct Assistant Professors*–Joel Kostka, Vijay Madisetti.

General Information

The School of Earth and Atmospheric Sciences is the principal academic unit at Georgia Tech focusing on the Earth, its physical and chemical environment, and its resources. All facets of the earth's system (including its geosphere, atmosphere, and hydrosphere) are studied within the School, and an Earth System Science approach is emphasized. These studies provide basic information for assessing the earth's resources and environmental quality, as well as the evolution of the Earth's environment and the possible future changes to this environment on the local, regional, and global scale.

The undergraduate degree program, instituted in 1993, offers students an introduction to the Earth System, including aspects of environmental science, by way of an holistic and integrative Earth System Science approach. The prime objective of our undergraduate program is to provide a technically rigorous education for the next generation of earth and atmospheric scientists, providing them with the qualitative and quantitative understanding of the complex interplay among the global dynamic systems of the earth, oceans, atmosphere, and biota. Selected courses in the degree program are designed to play an important service role in providing Earth System Science literacy to students of science, engineering, management, and public policy.

In the area of graduate education, the School offers programs leading to the Master of Science and Doctor of Philosophy degrees. Persons with a bachelor's degree in atmospheric science, biology, chemistry, engineering, geology, mathematics, meteorology, or physics, and a keen desire to understand the chemistry and physics of our natural environment, are invited to apply to the School's graduate program. Because of the varied backgrounds and interests of our students, the program of study for each student is typically adjusted to accommodate his or her needs.

The School's educational program is divided into three coupled and interdependent areas of specialization: 1) atmospheric sciences (including atmospheric chemistry, dynamics, and physics); 2) geochemistry; and 3) solid earth geophysics. In addition to these areas of specialization, students may carry out multidisciplinary studies in areas such as biospheric-atmospheric interactions, engineering geology, environmental studies and public policy, and remote sensing.

The School's research and study in oceanography is carried out in cooperation with the faculty of the Skidaway Institute of Oceanography at Savannah, Georgia. Students with interests in oceanography may conduct their thesis research at the Skidaway Institute after completing course work at Georgia Tech.

Undergraduate Program

The Bachelor of Science in Earth and Atmospheric Sciences program is based on 35 hours of core courses within the School and 41 hours of required courses in mathematics/computing and science. These ensure a strong foundation in Earth System Science, including "hands-on" experiences in environmental data gathering and interpretation and in predictive modeling. Electives (22 hours), both within the School and in other units of Georgia Tech, allow students considerable flexibility in tailoring their degree program according to individual career goals within earth and atmospheric sciences/earth system science fields. Appropriate selection of tracks, involving consultation with the School's undergraduate coordinator, will allow a student to proceed to further graduate study in the field or immediately to careers in, but not restricted to, such fields as environmental chemistry, environmental monitoring, remote sensing, exploration geophysics, geological engineering and geological hazards, impact assessment, meteorology, and environmental policy.

In addition to campuswide academic requirements for graduation with a bachelor's degree, the following are also required for the bachelor's degree in Earth and Atmospheric Sciences: a grade of *C* or better must have been earned in MATH 1501, MATH 1502, PHYS 2211, CHEM 1211, BIOL 1510, or 1520, and whichever computing course is taken to meet the departmental computing course requirement.

An undergraduate enrolled in another Georgia Tech school may develop a substantial background in the earth and atmospheric sciences by proper choice of electives within his or her own degree program. For example, the School of Physics recommends a specific set of upper-level courses for physics majors who are interested in solid earth geophysics.

Certificate Programs

The School of Earth and Atmospheric Sciences offers for non-School majors programs of study leading to certificates in two emphasis areas: surficial geochemistry and solid earth geophysics. Each course must be completed with a grade of *C* or better.

For details of the Geochemistry Certificate, contact Dr. Patricia M. Dove; for the Geophysics Certificate, contact Dr. L. Timothy Long.

Additional information regarding undergraduate programs is available by writing to the Undergraduate Coordinator, School of Earth and Atmospheric Sciences, Georgia Institute of Technology, Atlanta, Georgia 30332-0340.

BACHELOR OF SCIENCE IN EARTH AND ATMOSPHERIC SCIENCES (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
CHEM 1211	GENERAL CHEMISTRY	4
CS 1301	COMPUTER SCIENCE I	3
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS		16

First Year - Spring Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
CHEM 1311	INORGANIC CHEM. I	3
CHEM 1312	INORGANIC CHEM. LAB	1
EAS 1600	INTRO TO ENV. FIELD SCIENCE	4
TOTAL SEMESTER HOURS		15

Second Year - Fall Semester

Course Number/Name		*Hours*
MATH 2401	CALCULUS III	4
PHYS 2211	PHYSICS I	4
EAS 2601	EARTH PROCESSES	4
BIOL 1510 or 1520		4
TOTAL SEMESTER HOURS		16

Second Year - Spring Semester

Course Number/Name		*Hours*
MATH 2403	DIFFERENTIAL EQUATIONS	4
PHYS 2212	PHYSICS II	4
EAS 2602	EARTH THROUGH TIME	3
EAS 2650	QUANTITATIVE METHODS	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		18

Third Year - Fall Semester

Course Number/Name		*Hours*
EAS 3601	EARTH SYS. CHEM.	5
SOCIAL SCIENCE ELECTIVES		6
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		14

Third Year - Spring Semester

Course Number/Name		*Hours*
HUMANITIES ELECTIVE		3
EAS 3602	EARTH SYS. PHYSICS	5
SOCIAL SCIENCE ELECTIVE		3
TECHNICAL ELECTIVES		3
TOTAL SEMESTER HOURS		14

Fourth Year - Fall Semester

Course Number/Name		*Hours*
EAS 4420	ENVIRON. FIELD METHODS	4
EAS 4610	EARTH SYSTEMS MODELING	3
TECHNICAL ELECTIVES		9
TOTAL SEMESTER HOURS		16

Fourth Year - Spring Semester

Course Number/Name		*Hours*
EAS 4602	BIOGEOCHEMICAL CYCLES	3
FREE ELECTIVES		10
TOTAL SEMESTER HOURS		13

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Substitutions

With permission from the School, other courses in biology may be substituted for BIOL 1510-20, an alternative MATH/PHYS/CHEM course may be substituted for CHEM 1311-12.

Electives

Twelve hours of technical electives are required to provide further depth in a student's EAS curriculum, with a further 10 hours of free electives (total elective hours = 22) available to add breadth to his or her program in areas such as languages, environmental management, or public policy. Students should consult the School's undergraduate coordinator or assigned advisor for advice on their electives.

Humanities, Social Sciences, and Health Sciences Electives

See "Information for Undergraduates" for information relative to the Institute requirement of 12 hours of humanities and 12 hours of social sciences (pages 33-34). All students must satisfy a state requirement regarding course work in the history and constitutions of the United States and Georgia. HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200 fulfill this requirement. All students must satisfactorily complete a health sciences requirement, HPS 1040 or 1061, during their freshman year.

Graduate Program

Master's Degree Programs

There are three basic programs of study that lead to the Master of Science degree in the School of Earth and Atmospheric Sciences. These are the programs in atmospheric sciences, geochemistry, and solid earth geophysics. Multidisciplinary programs of study are also permitted upon the approval of the faculty of the School. In order to take the courses required in the graduate study program in earth and atmospheric sciences, students will need a background that includes a minimum of one year of university-level courses in calculus, chemistry, and physics. Students who enter without this background will be required to take remedial work without graduate credit.
In order to qualify for the Master of Science degree in the School of Earth and Atmospheric Sciences, a student must complete a faculty-approved set of academic courses and a thesis.

Students who wish to include more course work in a special technical area or not complete a thesis may pursue a program of study that does not meet all the requirements for the designated master's degree. Such a program of study must be approved by the School chair and must include a six-hour Special Research Problems course supervised by the student's advisor that includes a written final report. The nonthesis program leads to an undesignated Master of Science degree.

Graduate students in the School may also qualify for a Master of Science degree under the Multidisciplinary Program in Geohydrology by electing certain courses in hydrology (see the section "Multidisciplinary Programs in Engineering," page 122).

Doctoral Program

The major academic role in the School of Earth and Atmospheric Sciences is the education of graduate students pursuing the doctoral degree. Toward this end, the School has developed and will maintain an internationally recognized program of research with faculty that is both accessible to the students and active at the forefront of scientific investigation. Individuals with a strong background in the basic sciences and mathematics, the potential for high achievement in research, and a strong desire to expand humankind's knowledge and understanding of its physical and chemical environment are invited to apply to the School's doctoral program. A wide range of individual programs of study and research are available within the School's three main specialty areas and in earth system science combinations of these. Multidisciplinary programs are also permitted upon approval of the faculty.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

EARTH AND ATMOSPHERIC SCIENCES

EAS 1600. Introduction to Environmental Science
2-6-4. Co-requisite: MATH 1501.
Introduction to environmental field science. Case study approach. Exposure to basic field equipment and techniques, analysis of data.

EAS 1601. Habitable Planet
3-3-4.
Introduction to the origin and evolution of planet Earth, creation of the universe and the elements, early history of Earth, radioisotope geochemistry and the timing of events in the universe, the galaxy, and on Earth. Formation of the atmosphere and oceans. Climate.

EAS 2601. Earth Processes
3-3-4. Prerequisite(s): CHEM 1311 and CHEM 1312 and MATH 1502 and CS 1301; Co-requisites: MATH 2401 and PHYS 2211.
Broad perspective on the processes of the Earth that impact humankind. Project-based and problem-solving laboratory exercises.

EAS 2602. Earth through Time
3-0-3. Prerequisite(s): (BIOL 1510 or BIOL 1520) and EAS 2601
Dynamic processes affecting the Earth system on all time scales.

EAS 2650. Quantitative Techniques in Earth and Atmospheric Sciences
3-3-4. Prerequisite(s): MATH 2401 and PHYS 2211 and CHEM 1211; Co-requisites: MATH 2403 and PHYS 2212.
Integrated course in mathematical, physical, and computing techniques for application in earth and atmospheric sciences.

EAS 2750. Physics of the Weather
3-0-3.
An introductory treatment of the application of the basic physical laws to the understanding of weather phenomena. Crosslisted with PHYS 2750.

EAS 2801,-2,-3,-4. Special Topics
Credit and class hours equal last digit of course number.

EAS 2900. Special Problems
Credit hours to be arranged.

EAS 3601. Earth System Chemistry: Theory and Practice
4-3-5. Prerequisite(s): CHEM 1311 and CHEM 1312 and EAS 2650.
The chemistry and chemical processes that comprise and sustain the Earth system and its components, the solid earth, the hydrosphere, the atmosphere, and biosphere.

EAS 3602. Earth System Physics: Theory and Practice
4-3-5. Prerequisite(s): MATH 2403 and PHYS 2212 and EAS 2601 and EAS 2650.
Physics of the solid Earth, the atmosphere, and the hydrosphere. Basic structure, gravity, heat and energy transfer, fluids, waves, and magnetics as applied to the Earth system.

EAS 4200. Structural Geology and Continuum Mechanics
3-3-4. Prerequisite(s): EAS 2601 and PHYS 2211.
Structural geology and continuum mechanics for scientists and civil engineers. Stress and strain in rocks; faults, joints, and folds; basic field mapping; laboratory exercises.

EAS 4300. Oceanography
3-0-3.
Chemistry and physics of the ocean. Distributions of temperature, salinity, and density. Equations of state and motion. Surface and deep-water circulation. Waves and tides. Composition of seawater: dissolved sales, gases and nutrients. Biological processes. Marine sediments.

EAS 4420. Environmental Field Methods
2-6-4. Prerequisite(s): EAS 2601 and EAS 3601; Co-requisite: EAS 3602.
Semester-long focus on single environmental project in the local area. Chemical and physical techniques for parameterizing environmental problems, data analysis, report writing, and interpretation of results in societal context.

EAS 4430. Remote Sensing and Data Analysis
2-3-3.
Introduction to the remote sensing of the atmosphere and the Earth. Laboratory examples of data and image analysis for remote sensing applications.

EAS 4510. Exploration Geophysics
3-3-4. Prerequisite(s): EAS 3602.
Methods of exploration geophysics, including refraction and reflection seismology, resistivity, gravity, magnetics, and ground penetrating radar. Includes laboratory work and introduction to operation of field equipment.

EAS 4515. Fluids in the Earth's Crust I
3-0-3. Prerequisite(s): MATH 2403 and EAS 2601.
Fundamentals of porosity and permeability in soils, sediments, and crystalline rocks; basic physics of fluid flow through interconnected pore spaces and cracks; introductory analysis of fluid flow as an agent of heat and chemical transport in geological systems.

EAS 4520. Seismic Methods in Exploration Geophysics
3-0-3. Prerequisite(s): MATH 2403.
A study of seismic reflection exploration methods and theory. Examples are taken from oil industry exploration and production and near-surface environmental imaging.

EAS 4602. Biogeochemical Cycles
3-0-3. Prerequisite(s): EAS 3601 and EAS 3602 and (BIOL 1510 or BIOL 1520).
An investigation of global change focusing on the chemical, physical, geological, and biological processes that cycle the elements through the Earth system.

EAS 4610. Earth System Modeling
3-0-3. Prerequisite(s): AS 3601 and EAS 3602.
An introduction to computer modeling in Earth system science.

EAS 4620. Environmental Biogeochemistry of Soils and Sediments
3-3-4. Prerequisite(s): EAS 2601 and EAS 3601 and PHYS 2212.
Advanced study of the mineralogical and biochemical character of soil and sediment environments and the biological processes occuring in these subsurface systems.

EAS 4801,-2,-3,-4. Special Topics
Credit and hours equal last digit of course number.

EAS 4900. Special Problems
Credit hours to be arranged.

EAS 6111. The Earth System
2-0-2.
Exploration of processes linking the Earth and atmosphere.

EAS 6122. Biogeochemical Cycles
3-0-3.
A multidisciplinary exploration of the chemical, physical, geological, and biological processes that cycle the nutrient elements through the Earth system and thereby maintain a habitable planet.

EAS 6124. Principles of Oceanography
3-0-3.
Chemistry and physics of the ocean. Distributions of temperatures, salinity, and density. Equations of state and motion. Surface and deep-water circulation, waves and tides. Composition of seawater: dissolved salts, gases, and nutrients. Biological processes. Marine sediments.

EAS 6126. Global Tectonics
3-0-3. Prerequisite(s): EAS 3601 and EAS 3602.
Global tectonics from the integrated perspective of geophysical observations, geochemical fluxes, structural evolution of plate boundaries, and features within plates.

EAS 6128. Fluids in the Earth's Crust
3-0-3. Prerequisite(s): EAS 4515.
Advanced treatment of fluid flow, heat transfer, and reactive transport in porous and cracked rocks; stability of flow; double-diffusive systems; evolution of permeability in geologic systems; introduction to multiphase flow.

EAS 6132. Introduction to Climate Change
3-0-3.
The climate of the Earth, its radiation budget, greenhouse gases and their sources and sinks, potential changes due to anthropogenic activities, detection of climate changes.

EAS 6134. Inverse Methods and Time Series Analysis in Earth and Atmospheric Sciences
3-0-3.
Theory of data acquisition, time series analysis, and discrete inverse theory, with applications in the earth and atmospheric sciences.

EAS 6211. Geochemical Thermodynamics
3-0-3.
Fundamental principles of chemical equilibria in geochemical systems with emphasis on solution properties and mineral water equilibria.

EAS 6212. Geochemical Kinetics
3-0-3. Prerequisite(s): EAS 6211.
Fundamental principles of biogeochemical kinetics and mathematical treatment of coupled transport and reaction in natural environments. Interpretation of field and experimental data using kinetic theory.

EAS 6214. Aqueous Geochemistry
3-0-3. Prerequisite(s): EAS 6211.
Chemical processes that regulate compositions of natural waters at or near the Earth's surface, with emphasis on quantitative calculations of acid-base, solubility, and redox equilibria.

EAS 6216. Isotope Geochemistry
3-0-3.
Biogeochemical significance of nuclear isotopes, both radioactive and stable.

EAS 6221. Mineral Surface Geochemistry
3-0-3. Prerequisite(s): EAS 6212.
Interactions of aqueous solutions with the surface of minerals and particles with emphasis on molecular and thermodynamic models of ion sorption in complexation reactions, crystal growth, and dissolution processes in Earth environments.

EAS 6240. Organic Geochemistry
3-0-3.
Origin and transformation of organic matter in the Earth's environments, with emphasis on properties and reactions of highly complex mixtures such as humic substances.

EAS 6311. Physics of the Earth
3-0-3. Prerequisite(s): EAS 3602.
Physics of the Earth's interior. Composition and structure of core, mantle crust. Introduction to seismic wave propagation, gravitational, geomagnetic, and temperature fields.

EAS 6312. Geodynamics
3-0-3. Prerequisite(s): EAS 6311 and (EAS 6751 or CEE 6751).
Quantitative discussion of dynamical processes in the solid earth; viscous flow, glacial rebound, fluid dynamical instabilities, thermal convection; lithospheric dynamics; evolution of the core.

EAS 6314. Seismology
3-0-3. Prerequisite(s): EAS 6751 or CEE 6751.
The propagation of seismic waves, the description of earthquake motion and evaluation of earthquake damage. Examples provide experience in the interpretation of seismic data.

EAS 6320. Structural Geology and Continuum Mechanics
3-3-4. Prerequisite(s): EAS 2601.
Structural geology and continuum mechanics for scientists and civil engineers. Stress and strain in rocks; faults, joints, and folds; basic field mapping, laboratory exercises.

EAS 6330. Sedimentary Basin Anlaysis
3-0-3. Prerequisite(s): EAS 3602.
Analysis of continental and marine sedimentary basins, including deformation style, driving forces for basin information sedimentation and sequence stratigraphy, subsidence, hydrologic cycle, and hydrocarbon maturation.

EAS 6340. Computational and Theoretical Seismology
2-3-3. Prerequisite(s): EAS 6314.
Advanced topics in the theory and computation of seismic wave generation and propagation. Theory of earthquake sources, surface waves, ray paths, and wave propagation.

EAS 6401. Introduction to Atmospheric Chemistry
2-0-2.
Introduction to basic chemical principles related to chemical processes in the atmosphere.

EAS 6410. Atmospheric Chemistry
3-0-3.
Application of fundamental principles of chemistry to understanding the critical factors controlling the levels and distributions of atmospheric trace gases and their variation in time.

EAS 6412. Introduction to Physical Meteorology
3-0-3. Prerequisite(s): MATH 2403.
Application of the fundamental principles of thermodynamics to the atmosphere; including hydrostatic equilibrium and static stability, derivation of Claussius-Clapeyron Equation, cloud microphysics, radiative transfer, and the Earth's energy budget.

EAS 6420. Introduction to Principles of Atmospheric Chemical Instrumentation
3-3-4.
Introduction to the mechanical, electrical, and optical aspects of modern instrumentation used in atmospheric chemical research.

EAS 6421. Fundamentals of Instrumentation and Sensor Design in Atmospheric Chemistry
3-6-5. Prerequisite(s): EAS 6420.
Fundamental analysis of factors controlling sensitivity, and detectivity of research instrumentation used in atmospheric chemistry including derivations of signal strength relationships and the extraction of weak signals from atmospheric and instrument noise.

EAS 6501. Introduction to Atmospheric Dynamics
2-0-2.
Introduction to the basic fundamental fluid dynamics that control atmospheric motions.

EAS 6511. Introductory Fluid Dynamics and Synoptic Laboratory
2-3-3.
Fundamental principles of atmospheric fluid dynamics, analysis of meteorological codes, weather data and patterns, and numerical weather prediction products.

EAS 6512. Dynamic Meteorology
2-3-3. Prerequisite(s): EAS 6511.
An introduction to the use of geophysical fluid dynamics in describing and modeling the atmosphere.

EAS 6521. Tropospheric Dynamics
3-0-3. Prerequisite(s): EAS 6512.
Quasigeostrophic motion on a beta-plane. Conservation and invertibility of potential vorticity. Rossby waves, baroclinic and barotropic instability. Diagnostic analysis methods for large-scale tropospheric phenomena.

EAS 6530. Middle and Upper Atmospheric Dynamics
3-0-3.
The dynamics of the stratosphere, polar vortex, tropical "pump," ozone hole, wave activity, Elliasen-Palm Flux, and potential vorticity.

EAS 6751. Physical Properties and Rheology of Rocks
2-3-3. Prerequisite(s): EAS 3602.
Structure, physical properties, and rheology of minerals and rocks with applications to engineering structures and natural phenomena in the Earth. Fundamentals of rock mechanics and crack propagation. Crosslisted with CEE 6751.

EAS 6761. Contaminated Sediment Geochemistry
3-0-3. Prerequisite(s): EAS 6214.
Acquaints students with fate of major pollutants, nutrients, organic compounds, such as pesticides, PAH's and trace metals in sedimentary systems. Crosslisted with CEE 6761.

EAS 6765. Geomicrobiology
3-0-3. Prerequisite(s): EAS 3601 and (BIOL 4410 or BIOL 4418).
Interactions between microorganisms and the geosphere; microbial energetics and genetics; geochemical controls on

microbial diversity and activity; redox, and acid-base balances; biogeochemical cycles; evolution. Crosslisted with BIOL 6765.

EAS 6790. Air Pollution Physics and Chemistry
3-0-3.
Interaction to the physical and chemical processes affecting the dynamics and fate of air pollutants at the local, regional, and global scales. Particular emphasis is on tropospheric pollutant chemistry and transport. Crosslisted with CEE 6790.

EAS 6792. Air Pollution Meteorology and Chemistry
3-0-3.
Air pollution history, atmospheric stability and boundary layer dynamics, atmospheric dispersion, atmospheric transport, air pollution modeling. Crosslisted with CEE 6792.

EAS 6793. Atmospheric Boundary Layer
3-0-3.
Structure and dynamics of atmospheric boundary layers. Introduction to turbulence and turbulent transport. Crosslisted with CEE 6793.

EAS 6794. Atmospheric Chemical Modeling
3-0-3. Prerequisite(s): EAS 6410 and (EAS 6790 or CEE 6790).
Application of modern numerical methods to the prediction of atmospheric chemical and physical compositions; specific applications using computer models developed by the students are included. Crosslisted with CEE 6794.

EAS 6795. Atmospheric Aerosols
3-0-3. Prerequisite(s): EAS 6410 and (EAS 6790 or CEE 6790).
Chemical and physical properties of natural and anthropogenic aerosols. Sources, transport, transformation, and fate of primary/secondary, organic/inorganic, atmospheric semivolatiles and aerosols. Crosslisted with CEE 6795.

EAS 7000. Master's Thesis
Credit hours to be arranged.

EAS 7999. Preparation for Ph.D. Qualifying Exam
Credit hours to be arranged.

EAS 8001. Seminar
1-0-1.
A forum for graduate students in earth and atmospheric sciences to present and discuss topics related to their research interests.

EAS 8011,-2,-3. Seminar
Credit and class hours equal last digit of course number.
A forum for graduate students in earth and atmospheric sciences to present and discuss topics related to their research interests.

EAS 8801,-2,-3,-4,-5,-6. Special Topics
Credit and class hours equal last digit of course number.

EAS 8823. Special Topics with a Laboratory
2-3-3.

EAS 8824. Special Topics with a Laboratory
3-3-4.

EAS 8825. Special Topics with a Laboratory
3-6-5.

EAS 8901,-2,-3,-4. Special Problems
Credit hours to be arranged.

EAS 8997. Teaching Assistantship
Credit hours to be arranged.

EAS 8998. Research Assistantship
Credit hours to be arranged.

EAS 8999. Preparation for Doctoral Dissertation
Credit hours to be arranged.

EAS 9000. Doctoral Thesis
Credit hours to be arranged.

Department of Health and Performance Sciences

Established in 1990
(formerly Physical Education and Recreation, established 1942)
Location: Callaway Student Athletic Complex, Centennial Research Building
Telephone: (404) 894-3986
Website: www.hps.gatech.edu

Department Head and Professor–Robert J. Gregor; *Associate Department Head and Professor*–James A. Reedy; *Professors*–Phillip B. Sparling; *Associate Professors*–Mindy Millard-Stafford, Bill D. Beavers; *Assistant Professors*–Mark D. Geil; *Research Associate II*–Linda B. Rosskopf; *Research Associates I*–Elizabeth O'Donnell, Teresa Snow.

General Information

The curriculum and programs of the Department of Health and Performance Sciences are based on the premise that sound health practices and basic neuromuscular skills are important to the total education and peak performance of the individual, as well as the foundations of a balanced and productive life. The Department, therefore, offers unique experiences to educate and motivate students toward a lifetime commitment to optimal personal health and to assist each student in obtaining the necessary knowledge and skills to achieve and maintain it. Moreover, the Department offers upper-level courses in the exercise and movement sciences to augment professional preparation for careers in science, engineering, and medicine.

The Health Sciences Requirement

All Georgia Tech students must satisfactorily complete the health science requirement. It is recommended the requirement be taken during the freshman year and consists of one two-hour course, either HPS 1040, Health Concepts and Strategies, or HPS 1061, Fitness Concepts: A Wellness Approach. It is suggested that students with physical disabilities enroll in HPS 1040 rather than HPS 1061. The Department may grant credit to transfer students for comparable courses completed at other institutions. Students who have completed their health science requirement are encouraged to elect additional courses of interest in health and movement science.

Other Health and Performance Sciences (HPS) courses may be used as free electives or technical electives, if approved by the major school. Individual schools may allow up to three hours of courses to be counted toward degree requirements. Students should check the curricula of their individual schools to determine the number of hours they may apply toward the degree.

To supplement the experiences in the health sciences requirement, students are encouraged to participate in associated programs sponsored by the Department and the Division of Student Affairs, including those offered by the Wellness Center headquartered at the Student Health Center.

Certificate Program in Health Sciences

The Department of Health and Performance Sciences, in conjunction with the School of Biology, offers a multidisciplinary certificate program in the health sciences. It is designed for students from any major who wish to broaden or supplement their educational experiences and career opportunities in areas related to the health sciences, human biology, bioengineering or biomedical engineering. The certificate program is based in human anatomy, physiology and kinesiology, but allows students the flexibility to elect courses in specific areas of interest such as personal health, exercise science, or kinesiological bases of movement. HPS 3751 (Human Anatomy & Physiology) is required with other courses selected from an approved list. Specific information regarding the certificate may be obtained by contacting the HPS Office in the Callaway Student Athletic Complex at (404) 894-3986.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

HEALTH AND PERFORMANCE SCIENCES

HPS 1002. Aerobic Conditioning: Cross Training
0-2-1
Development of cardiorespiratory endurance through a variety of aerobic activities: stationary cycling, rowing, stair climbing, treadmill, and other activities.

HPS 1004. Aerobic Conditioning: Running
0-2-1.
Primary emphasis on improvement of cardiorespiratory endurance, through an individually tailored program of jogging/running and stretching.

HPS 1006. Aerobic Dance
0-2-1.
Improvement of flexibility, strength, and primarily cardiorespiratory endurance through basic dance exercise. Course components also include fitness assessment and weight control.

HPS 1008. Aerobic Conditioning: Swimming
0-2-1.
Primary emphasis on improvement of cardiorespiratory endurance, as well as flexibility and muscular endurance, through an individualized program of swimming and other aquatic exercises. Intermediate swimming skills required.

HPS 1010. Physical Conditioning: Strength Training
0-2-1.
Instruction and demonstration of basic conditioning with emphasis on muscular strength and endurance. Includes training principles and safety precautions.

HPS 1040. Health Concepts and Strategies
2-0-2.
Scientifically based and current medical information presented through lecture, laboratory, and self-directed study enabling increased knowledge, the development of strategies, and the promotion of self-responsibility for enhancing personal health.

HPS 1061. Fitness Concepts: A Wellness Approach
1-2-2.
Basic concepts on which lifetime fitness/wellness programs are founded. Emphasizes the role of exercise in health and quality of life. Includes assessment and development of a personal fitness program.

HPS 3400. Issues of Drug and Substance Use
2-0-2. Prerequisite(s): HPS 1040 or HPS 1061
Class presentations and discussions of contemporary substance use and abuse issues, following an overview of drug use history, legislation, pharmacology, and selected abusable drugs.

HPS 3500. Nutrition and Health
2-0-2. Prerequisite(s): HPS 1040 or HPS 1061
Study of human nutrition as an applied science. Nutrition physiology: metabolism, energy, production, biochemical aspect, role of nutrients, weight control mechanisms, and preventative nutrition in health management will be covered.

HPS 3751. Human Anatomy and Physiology
3-0-3. Prerequisite(s): BIOL 1510 or CHEM 1211
Study of human anatomy and fundamental physiological mechanisms with concentration on skeletal, muscular, nervous, circulatory, respiratory, digestive, urinary, endocrine, and reproductive systems. Crosslisted with BIOL 3751.

HPS 3801,-2,-3. Special Topics in Exercise Science
Credit and class hours equal last digit of course number. Prerequisite(s): HPS 1040 or HPS 1061
Current topics in exercise science.

HPS 3901,-2,-3. Special Problems in Exercise Science
Credit hours to be arranged.

HPS 4100. Exercise Physiology
2-3-3. Prerequisite(s): HPS 3751 or BIOL 3751
Physiology of human movement with emphasis on metabolic, cardiorespiratory, and musculoskeletal aspects; associated topics include body composition, thermoregulation, and ergogenic aids.

HPS 4200. Kinesiological Basis of Human Movement
2-3-3.
Analysis of human movement from the broad perspectives of kinesiology, neural control, and human anatomy, to include the study of locomotion in both healthy and clinical populations, tasks and various movements of the upper extremities.

School of Mathematics

Established in 1952
Location: Skiles Building
Telephone: (404) 894-2700
Fax: (404) 894-4409
Web address: www.math.gatech.edu

Chair and Professor–Richard Duke; *Associate Chair and Associate Professor*–Dar-Veig Ho; *Coordinator of Graduate Programs and Professor*–William L. Green; *Coordinator of Undergraduate Programs and Professor*–Eric A. Carlen; *Regents' Professors*–William F. Ames (emeritus), Leonid Bunimovich, Jack K. Hale (emeritus); *Professors*–Alfred D. Andrew, Johan G. F. Belinfante, Mark Borodovsky, George L. Cain Jr., Shui-Nee Chow, Jiangang Dai, Jeffrey S. Geronimo, Jamie J. Goode (emeritus), Evans M. Harrell, James V. Herod (emeritus), Theodore P. Hill, Robert H. Kasriel (emeritus), Robert P. Kertz, Michael Loss, Gunter H. Meyer, Konstantin Mischaikow, Thomas D. Morley, Daniel A. Robinson, Ronald W. Shenk, M. Carl Spruill, Michael P. Stallybrass, Robin Thomas, Yung L. Tong; *Associate Professors*–Nathaniel Chafee, Xu-Yan Chen, Luca Dieci, Donald Estep, Donald M. Friedlen (emeritus), Christian Houdré, Shi Jin, Roger D. Johnson (emeritus), Michael T. Lacey, Wing-Suet Li, John P. Line (emeritus), James M. Osborn (emeritus), E. Juanita Pitts (emerita), William R. Smythe Jr. (emeritus), Jonathan E. Spingarn, Frank W. Stallard (emeritus), Yang Wang, Yingfei Yi, Xingxing Yu; *Assistant Professors*–Mihai Ciucu, Laszlo Erdös, Wilfred D. Gangbo, Robert W. Ghrist, Christopher Heil, Daniel A. Klain, Dana Randall, Andrzej Swiech, Prasad Tetali; *Instructors*–Rena Brakebill, Klara Grodzinsky.

General Information

Mathematics forms an integral part of the curricula of most students at Georgia Tech. Consequently, the School of Mathematics offers a wide range of courses serving students in the various engineering, science, and management disciplines. In addition, the School offers programs of study leading to the bachelor's, master's, and doctoral degrees in mathematics. Such programs of study serve as preparation for mathematics careers, professional schools, and graduate studies.

In addition to basic courses in mathematics, the School offers a variety of specialized courses at the undergraduate and graduate levels, emphasizing areas related to the research activities of the faculty. At present, these include mathematical analysis, applied mathematics, differential equations and partial differential equations, geometry, scientific computing, probability, statistics, combinatorics, mathematical physics, topology, and algebra.

The School of Mathematics has excellent computer facilities that are used in conjunction with an increasing number of courses and programs of study. A cooperative plan for students who wish to combine practical experience with academic work is available for mathematics majors.

Undergraduate Program

The School of Mathematics offers programs leading to two undergraduate degrees: the Bachelor of Science in Applied Mathematics and the Bachelor of Science in Discrete Mathematics. Both programs emphasize the study of core mathematics as well as its applications. They provide excellent preparation for employment as well as graduate study in mathematics and related fields.

Applied Mathematics

Reflecting the scientific environment at Georgia Tech, the bachelor's program in applied mathematics trains students in the traditional core mathematics curriculum, as well as in its applications. The undergraduate program is sufficiently flexible to accommodate the wide variety of interests of undergraduate majors, and yet by its scientific breadth, it prepares the student for the extensive employment opportunities that exist for applied mathematicians. Students are encouraged to develop an expertise in another field related to mathematics. This can be accomplished by developing a program of study involving technical electives and an appropriate concentration within mathematics. Some of the more popular fields include physics, computer science, electrical engineering, industrial engineering, operations research, economics, and management. In addition, the School of Mathematics has a large, well networked computer lab that is utilized in courses throughout the undergraduate curriculum. Students may count no more than two hours of course work in physical education toward graduation. Only free electives or MATH 4999 in the degree program may be taken on a pass/fail basis, and no more than nine hours are allowed under this option.

In addition to the institutional requirement of at least a 2.0 grade point average for the entire academic program, the School of Mathematics requires a grade of *C* or better in each of MATH 4107, 4317, 4318, and 4320.

Bachelor of Science in Applied Mathematics (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION	3
MATH 1501	CALCULUS I	4
HPS 1040/1061	WELLNESS	2
CS 1301	COMPUTER SCIENCE I	3
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		15

First Year - Spring Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION	3
MATH 1502	CALCULUS II	4
LAB SCIENCE	(EAS, CHEM, BIOL)	4
CS 1302	COMPUTER SCIENCE II	3
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		17

Second Year - Fall Semester

Course Number/Name		*Hours*
MATH 2401	CALCULUS III	4
PHYS 2211	PHYSICS I	4
HUMANITIES ELECTIVE		3
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		14

Second Year - Spring Semester

Course Number/Name		*Hours*
MATH 2402	LINEAR ALGEBRA	3
MATH 2403	DIFFERENTIAL EQUATIONS	4
PHYS 2212	PHYSICS II	4
HUMANITIES ELECTIVE		3
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		17

Third Year - Fall Semester

Course Number/Name		*Hours*
MATH 3012	APPLIED COMBINATORICS	3
3XXX ELECTIVE (ENGINEERING OR SCIENCE)		3
MATH 3XXX ELECTIVE		6
FREE ELECTIVE		3
TOTAL SEMESTER HOURS		15

Third Year - Spring Semester

Course Number/Name		*Hours*
MATH 3215	PROBABILITY & STATISTICS	3
MATH 3XXX	ELECTIVES	9
3XXX ELECTIVE (ENGINEERING OR SCIENCE)		3
TOTAL SEMESTER HOURS		15

Fourth Year - Fall Semester

Course Number/Name		*Hours*
MATH 4107	ABSTRACT ALGEBRA I	3
MATH 4320	COMPLEX ANALYSIS	3
MATH 4317	ANALYSIS I	3
PHYS 3XXX ELECTIVE		3
FREE ELECTIVE		2
TOTAL SEMESTER HOURS		14

Fourth Year - Spring Semester

Course Number/Name		*Hours*
MATH 4318	ANALYSIS II	3
MATH 4640	NUMERICAL ANALYSIS I	3
FREE ELECTIVE		9
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Substitutions

Honors physics and mathematics courses may be substituted for the corresponding regular courses.

Electives

Humanities and Social Sciences Electives

The School of Mathematics recommends that students take a one-year sequence of courses in a modern language and that they begin the sequence of required 4000-level mathematics courses in the junior year. All students must satisfy a state requirement regarding course work in the history and constitutions of the U.S. and Georgia by taking one course from HIST 2111, HIST 2112, INTA 1200, POL 1101, or PUBP 3000.

Discrete Mathematics

Certain areas of mathematics have become increasingly important over the past 20 years due to the introduction of computing into nearly every aspect of science, technology, and business. These are the branches of mathematics that are devoted to the study of "discrete" as opposed to "continuous" structures. The methods of discrete mathematics are used whenever objects are to be counted, when the relationships between finite sets are examined, and when processes involving a finite number of steps are studied. These methods become essential when, for example, computer algorithms are analyzed, transportation networks or communications systems are designed, or when optimal schedules are sought. Many problems associated with the transmission and storage of information, the design of complicated circuits, or the identification of organic chemicals require the tools of discrete mathematics. Several fields of application, most notably operations research and computer science, not only use the techniques of discrete mathematics, but have also contributed significantly to the development of the subject. For this reason, the curriculum for this bachelor's degree program combines basic work in mathematics and science and advanced studies in discrete mathematics with substantial training in these areas of application. After completion of the program's core requirements in the first two years, students take 18 hours of mathematics, 6 hours of computer science, and 6 hours of systems engineering. Nine hours of approved technical electives are to be selected from an approved list of courses in mathematics, computing, electrical engineering, and operations research. Four hours for the senior research project and 12 hours of free electives complete the program.

Bachelor of Science in Discrete Mathematics (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION	3
MATH 1501	CALCULUS I	4
HPS 1040/1061	WELLNESS	2
CS 1301	COMPUTER SCIENCE I	3
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		15

First Year - Spring Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION	3
MATH 1502	CALCULUS II	4
LAB SCIENCE	(EAS, CHEM, BIOL)	4
CS 1302	COMPUTER SCIENCE II	3
CS 1050	PROOFS	3
TOTAL SEMESTER HOURS		17

Second Year - Fall Semester

Course Number/Name		*Hours*
MATH 2401	CALCULUS III	4
PHYS 2211	PHYSICS I	4
HUMANITIES ELECTIVE		3
SOCIAL SCIENCE ELECTIVES		6
TOTAL SEMESTER HOURS		17

Second Year - Spring Semester

Course Number/Name		*Hours*
MATH 2402	LINEAR ALGEBRA	3
MATH 2602	LINEAR & DISCRETE MATH.	4
PHYS 2212	PHYSICS II	4
HUMANITIES ELECTIVE		3
SOCIAL SCIENCE ELECTIVE		3
TOTAL SEMESTER HOURS		17

Third Year - Fall Semester

Course Number/Name		*Hours*
MATH 3012	APPLIED COMBINATORICS	3
CS 2330	LANGUAGES & TRANSLATION	4
CS 3500	THEORY I	4
FREE ELECTIVES		6
TOTAL SEMESTER HOURS		17

Third Year - Spring Semester

Course Number/Name		*Hours*
MATH 3215	PROBABILITY & STATISTICS	3
CS 4500	THEORY II	3
ISYE 4231	ENGINEERING OPTIMIZATION	3
TECHNICAL ELECTIVE		3
TOTAL SEMESTER HOURS		12

Fourth Year - Fall Semester

Course Number/Name		*Hours*
MATH 4080	SENIOR PROJECT I	2
MATH 4107	ABSTRACT ALGEBRA I	3
MATH 4022	INTRO. TO GRAPH THEORY	3
MATH 4317	ANALYSIS I	3
TECHNICAL ELECTIVE		3
TOTAL SEMESTER HOURS		14

Fourth Year - Spring Semester

Course Number/Name		*Hours*
MATH 4090	SENIOR PROJECT II	2
ISYE 3332	RANDOM SYSTEMS	3
TECHNICAL ELECTIVES		3
FREE ELECTIVES		5
TOTAL SEMESTER HOURS		13

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Substitutions

PHYS 2141-2-3 may be substituted for PHYS 2121-2-3. MATH 4580 may be substituted for ISyE 3231. Honors physics and math courses may be substituted for the corresponding regular courses.

Electives

English Elective

Any English course that carries humanities credit.

Health and Performance Sciences

A maximum of three hours of PE may be used toward degree requirements.

Humanities and Social Sciences

The School of Mathematics recommends that students take a one-year sequence of courses in a modern language and that they begin the sequence of required 4000-level mathematics courses in the junior year. All students must satisfy a state requirement regarding course work in the history and constitutions of the U.S. and Georgia by taking one course from HIST 2111, HIST 2112, INTA 1200, POL 1101, or PUBP 3000.

Graduate Programs

The School of Mathematics provides opportunities for study in a wide range of mathematical disciplines. First-year graduate sequences include algebra, analysis, differential equations, numerical analysis, probability, statistics, and topology in addition to courses in methods of applied mathematics.

A program of study leading to a master's degree should include analysis consisting of MATH 6327 and either MATH 6580 or MATH 7334. In addition, students should take 6 hours of course work, subject to the approval of the School of Mathematics, at the 4000 level or higher outside the School. The program should also include either a thesis (9 thesis hours) and 9 additional hours of course work at the 4000 level or higher, or an additional 18 hours of course work at the 4000 level or higher, including at least 12 hours at the 6000 level or higher in mathematics. Under the nonthesis option, the program must include a concentration consisting of 6 hours of course work at the 6000 level or higher in a field of mathematics chosen in consultation with the student's advisor, and a sufficient number of hours at the 6000 level or higher to ensure that the program includes a total of at least 21 hours at this level. Under either of these options, MATH 6701 and 6702, as well as all courses required by number for the Bachelor of Science in Applied Mathematics (MATH 3012, 3215, 4107, 4317, 4318, 4320, and 4640), do not carry degree credit for graduate mathematics majors and may not be used to fulfill these degree requirements.

Students must maintain an overall grade point average of at least 3.0 and receive a grade of *C* or better in each mathematics course in the program of study.

Before admission to candidacy for the master's degree, each student must pass either a master's oral comprehensive examination or the written portion of the mathematics doctoral comprehensive examination.

The doctoral program requires 51 hours of course work, with grades of *C* or better, beyond the undergraduate degree. At least 36 hours, chosen to the satisfaction of the student's research advisor and the School's Graduate Committee, must be taken at the 6000 level in mathematics, and a further 9 hours must be taken outside the School of Mathematics at the 4000 level or higher in the student's minor field of study. The program must also include 6 additional hours at the 6000 level. Work on a master's thesis (thesis hours) may not be counted toward any of the 51 hours specified above, but course work for the master's degree may be counted. At least 6 hours of the minor should be completed within 3 years of the student's admission to the doctoral program.

Prior to admission to candidacy for the doctoral degree, each student must pass the comprehensive examination, which consists of a written examination in real analysis and linear analysis and an oral examination in the student's proposed area of specialization. Doctoral students must also satisfy the Institute requirements with respect to the dissertation and final oral examination.

Center for Dynamical Systems and Nonlinear Studies

As part of the research and graduate programs in the School of Mathematics, the Center for Dynamical Systems and Nonlinear Studies sponsors distinct but interrelated activities in dynamical systems, differential equations, and nonlinear analysis and applications. The Center offers postdoctoral and visiting faculty appointments as well as financial aid to graduate students affiliated with the Center. The director of the Center is Professor Konstantin Mischaikow.

Southeastern Applied Analysis Center

Georgia Tech's Southeastern Applied Analysis Center, directerd by Leonid Bunimovich, is a regional resource for research and education in applied mathematics, and for outreach to inudstry. The Center sponsors regional and international conferences and organizes focused research in many areas of mathematics and applications.

Program in Algorithms, Combinatorics, and Optimization

One of the most rapidly growing areas of research in applied mathematics, computer science, and operations research has been that dealing with discrete structures. This has been most evident in the fields of combinatorics, discrete optimization, and the analysis of algorithms. Increasingly, work in each of these subjects has come to depend on knowledge of all of them. Indeed, many of the most significant advances have resulted from the efforts of researchers in more than one, if not all three, of these areas.

In response to these developments, Georgia Tech has introduced a doctoral degree program in algorithms, combinatorics, and optimization (ACO). This multidisciplinary program is sponsored jointly by the School of Mathematics, the School of Industrial and Systems Engineering, and the College of Computing. Faculty for the program are drawn from these three sponsoring units, as well as from the School of Electrical and Computer Engineering and the DuPree College of Management.

The ACO program is arranged to bring together the study of discrete structures and the design and analysis of algorithms in areas such as graph theory, integer programming, combinatorial optimization, and polyhedral theory. It is intended for students possessing a strong background in one or more of the fields represented by the three sponsoring units. Each student in the program has a single home department chosen from the School of Mathematics, the School of Industrial and Systems Engineering, and the College of Computing. Courses for the program are drawn from all three of these units, and include study in such areas as combinatorial methods, algebraic structures, probability, the analysis of algorithms, computational complexity, linear programming, discrete optimization, and convex analysis.

Program in Statistics

For information concerning the graduate program in statistics, refer to page 171.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

MATHEMATICS

MATH 1113. Precalculus
4-0-4.
Analytic geometry, the function concept, polynomials, exponential, logarithms, trigonometric functions, mathematical induction, and the theory of equations.

MATH 1501. Calculus I
4-0-4. Prerequisite(s): MATH 1113 or S02 550
Differential calculus and basic integral calculus including the fundamental theorem of calculus and Taylor's theorem with remainder. Credit not allowed for both MATH 1501 and 1712.

MATH 1502. Calculus II
4-0-4. Prerequisite(s): MATH 1501 or MATH 1511
This course concludes the treatment of single variable calculus and begins linear algebra, the linear basis of the multivariable theory. Credit not allowed for both MATH 1501 and 1712.

MATH 1511. Honors Calculus
4-0-4.
The topics covered parallel those of 1501 with a somewhat more intensive and rigorous treatment. Credit not allowed for both honors calculus and the corresponding regular calculus course.

MATH 1512. Honors Calculus II
4-0-4. Prerequisite(s): MATH 1511
The topics covered parallel those of 1502 with a somewhat more intensive and rigorous treatment. Credit not allowed for both honors calculus and the corresponding regular calculus course.

MATH 1601. Introduction to Higher Mathematics
3-0-3. Prerequisite(s): MATH 1501 or MATH 1511
This course is designed to teach problem solving and proof writing. Mathematical subject matter is drawn from elementary number theory and geometry.

MATH 1711. Finite Mathematics
4-0-4. Prerequisite(s): S02 550
Linear equations, matrices, linear programming, sets and counting, probability, and statistics. Credit not allowed for both MATH 1501 and 1712.

MATH 1712. Survey of Calculus
4-0-4. Prerequisite(s): MATH 1711
Techniques of differentiation, integration, application of integration to probability and statistics, multidimensional calculus. Credit not allowed for both MATH 1712 and 1501.

MATH 2401. Calculus III
4-0-4. Prerequisite(s): MATH 1502 or MATH 1512
Multivariable calculus: Linear approximation and Taylor's theoroms, Lagrange multiples and constrained optimization, multiple integration and vector analysis including the theorems of Green, Gauss, and Stokes.

MATH 2402. Introduction to Linear Algebra
3-0-3. Prerequisite(s): MATH 2401 or MATH 2411
A thorough development of the theory of linear algebra and an introduction to multilinear algebra, with selected applications.

MATH 2403. Differential Equations
4-0-4. Prerequisite(s): MATH 1502 or MATH 1512
Methods for obtaining numerical and analytic solutions of elementary differential equations. Applications are also discussed with an emphasis on modeling.

MATH 2411. Honors Calculus III
4-0-4. Prerequisite(s): MATH 1512
The topics covered parallel those of MATH 2401 with a somewhat more intensive and rigorous treatment. Credit is not allowed for both honors calculus and the corresponding regular calculus course.

MATH 2413. Honors Differential Equations
4-0-4. Prerequisite(s): MATH 2401 or MATH 2411
The course treats the theory of ordinary differential equations from an advanced perspective, delving into the theory as well as computational aspects. It is designed for mathematics majors and others who wish to take advanced courses in the area.

MATH 2601. Calculus III for Computer Science
3-0-3. Prerequisite(s): MATH 1502 or MATH 1512
Topics in linear algebra and multivariate calculus and their applications in optimization and numerical methods, including curve fitting, interpolation, and numerical differentiation and integration.

MATH 2602. Linear and Discrete Mathematics
4-0-4. Prerequisite(s): MATH 2401 or MATH 2411
Topics in linear algebra, sequences, differences, finite sums and difference equations, multivariate optimization with an emphasis in discrete and recursive methods.

MATH 2801,-2,-3,-4,-5. Special Topics
3-0-3, each.
Courses on special topics of current interest in mathematics.

MATH 3012. Applied Combinatorics
3-0-3. Prerequisite(s): MATH 1502 or MATH 1512 or MATH 1711
Elementary combinatorial techniques used in discrete problem solving: counting methods, solving linear recurrences, graph and network models, related algorithms, and combinatorial designs.

MATH 3215. Introduction to Probability and Statistics
3-0-3. Prerequisite(s): MATH 2401 or MATH 2411
This course is a problem-oriented introduction to the basic concepts of probability and statistics, providing a foundation for applications and further study.

MATH 3770. Statistics and Applications
3-0-3. Prerequisite(s): MATH 2401 or MATH 2411.
Introduction to probability, probability distributions, point estimation, confidence intervals, hypothesis testing, linear regression and analysis of variance. This course may not be taken for credit by math majors. Crosslisted with ISYE 3770.

MATH 3801,-2,-3,-4,-5. Special Topics
3-0-3, each.
Courses on special topics of current interest in mathematics.

MATH 4012. Algebraic Structures in Coding Theory
3-0-3. Prerequisite(s): MATH 1502 or MATH 1512
Introduction to linear error-correcting codes with an emphasis on the algebraic tools required, including matrices vector spaces, groups, polynomial rings, and finite fields.

MATH 4022. Introduction to Graph Theory
3-0-3. Prerequisite(s): MATH 3012
The fundamentals of graph theory: trees, connectivity, Euler torus, Hamilton cycles, matchings, colorings, and Ramsey theory.

MATH 4032. Combinatorial Analysis
3-0-3. Prerequisite(s): MATH 3012
Combinatorial problem-solving techniques including the use of generating functions, recurrence relations, Polya theory, combinatorial designs, Ramsey theory, matroids, and asymptotic analysis.

MATH 4080. Senior Project I
2-0-2.
The first of a two-course sequence of faculty-directed independent research culminating in the writing of a senior thesis and its presentation.

MATH 4090. Senior Project II
2-0-2.
The second course of a two-course sequence of faculty-directed independent research culminating in the writing of a senior thesis and its presentation.

MATH 4107. Abstract Algebra I
3-0-3. Prerequisite(s): MATH 2402
This course develops in the theme of "Arithmetic congruence, and abstract algebraic structures." Strong emphasis on theory and proofs.

MATH 4108. Abstract Algebra II
3-0-3. Prerequisite(s): MATH 4107
Continuation of Abstract Algebra I, with emphasis on Galois theory, modules, polynomial fields, and the theory of linear associative algebra.

MATH 4150. Introduction to Number Theory
3-0-3. Prerequisite(s): MATH 2402
Primes and unique factorization, congruences, Chinese remainder theorem, Diophantine equations, Diophantine approximations, quadratic reciprocity. Applications such as fast multiplication, factorization, and encryption.

MATH 4221. Stochastic Processes I
3-0-3. Prerequisite(s): MATH 4215
Simple random walk and the theory of discrete time Markov chains.

MATH 4222. Stochastic Processes II
3-0-3. Prerequisite(s): MATH 4221
Renewal theory, Poisson processes, and continuous-time Markov processes, including an introduction to Brownian motion and martingales.

MATH 4225. Honors Probability and Statistics
3-0-3. Prerequisite(s): MATH 2401 or MATH 2411
Topics covered parallel those of MATH 4215, with a more rigorous and intensive treatment. Credit not allowed for both MATH 4215 and 4225.

MATH 4261. Mathematical Statistics I
3-0-3. Prerequisite(s): MATH 4215
Sampling distributions, Normal, t, chi-square, and f distributions. Moment generating function methods, Bayesian estimation, and introduction to hypothesis testing.

MATH 4262. Mathematical Statistics II
3-0-3. Prerequisite(s): MATH 4261
Hypothesis testing, likelihood ratio tests, nonparametric tests, bivariate and multivariate normal distributions.

MATH 4280. Introduction to Information Theory
3-0-3. Prerequisite(s): MATH 4215
The measurement and quantification of information. These ideas are applied to the probabilistic analysis of the transmission of information over a channel along which random distortion of the message occurs.

MATH 4305. Topics in Linear Algebra
3-0-3. Prerequisite(s): MATH 1502 or MATH 1512
Finite dimensional vector spaces, inner product spaces, least squares, linear transformations, the spectral theorem for normal transformations. Applications to convex sets, positive matrices, difference equations.

MATH 4317. Analysis I
3-0-3. Prerequisite(s): MATH 2402
Real numbers, topology of Euclidean spaces, Cauchy sequences, completeness, continuity and compactness, uniform continuity, series of functions, Fourier series.

MATH 4318. Analysis II
3-0-3. Prerequisite(s): MATH 4317
Differentiation of functions of one real variable, Riemann-Stieltjes integral, the derivative in Rn, and integration in Rn.

MATH 4320. Complex Analysis
3-0-3. Prerequisite(s): MATH 1502 or MATH 1512 or MATH 2401 or MATH 2411
Topics from complex function theory, including contour integration and conformal mapping.

MATH 4347. Partial Differential Equations I
3-0-3. Prerequisite(s): MATH 2402 and (MATH 2403 or MATH 2413)
Method of characteristics for first and second quarter partial differential equations, conservation laws and shocks, classification of second-order systems and applications.

MATH 4348. Partial Differential Equations II
3-0-3. Prerequisite(s): MATH 4347
Green's functions and fundamental solutions. Potential, diffusion, and wave equations.

MATH 4431. Introduction to Topology
3-0-3. Prerequisite(s): MATH 4317
Point set topology, topological spaces and metric spaces, continuity and compactness, homotopy and covering spaces.

MATH 4432. Introduction to Algebraic Topology
3-0-3. Prerequisite(s): MATH 4317
Introduction to algebraic methods in topology. Includes homotopy, the fundamental group, covering spaces, simplicial complexes. Applications to fixed point theory and group theory.

MATH 4441. Differential Geometry
3-0-3. Prerequisite(s): MATH 2402
The theory of curves, surfaces, and more generally, manifolds. Curvature, parallel transport, covariant differentiation, Gauss-Bonet theorem.

MATH 4541. Dynamics and Bifurcations I
3-0-3. Prerequisite(s): MATH 2403 or MATH 2413
A broad introduction to the local and global behavior of nonlinear dynamical systems arising from maps and ordinary differential equations.

MATH 4542. Dynamics and Bifurcations II
3-0-3. Prerequisite(s): MATH 4541
A continuation of Dynamics and Bifurcations I.

MATH 4580. Linear Programming
3-0-3. Prerequisite(s): MATH 1502 or MATH 1512 or MATH 1712
A study of linear programming problems, including the simplex method, duality, and sensitivity analysis with applications to matrix games, interger programming, and networks.

MATH 4581. Classical Mathematical Methods in Engineering
3-0-3. Prerequisite(s): MATH 2403 or MATH 2413
The Laplace transform and applications, Fourier series, boundary value problems for partial differential equations.

MATH 4640. Numerical Analysis I
3-0-3. Prerequisite(s): MATH 2502
Introduction to numerical algorithms for some basic problems in computational mathematics. Discussion of both implementation issues and error analysis.

MATH 4641. Numerical Analysis II
3-0-3. Prerequisite(s): MATH 4640
Introduction to the numerical solution of initial and boundary value problems in differential equations.

MATH 4755. Mathematical Biology
3-0-3. Prerequisite(s): MATH 1502 or MATH 1512
Problems from the life sciences and the mathematical methods for solving them are presented. The underlying biological and mathematical principles and the interrelationships are emphasized. Crosslisted with BIOL 4755.

MATH 4777. Vector and Parallel Scientific Computation
3-0-3. Prerequisite(s): MATH 2502
Scientific computational algorithms on vector and parallel computers. Speedup and algorithm complexity, interprocesses communication, synchronization, modern algorithms for linear systems, programming techniques, code optimization. Crosslisted with CS 4777.

MATH 4801,-2,-3,-4,-5. Special Topics
3-0-3, each.
Courses on special topics of current interest in mathematics.

MATH 4999. Special Problems
Credit hours to be arranged.
Reading or research in topics of current interest.

MATH 6014. Graph Theory
3-0-3. Prerequisite(s): MATH 4022
Fundamentals, connectivity, matchings, colorings, extremal problems, Ramsey theory, planar graphs, perfect graphs. Applications to operations research and the design of efficient algorithms.

MATH 6021. Topology of Euclidean Spaces
3-0-3. Prerequisite(s): MATH 4317 and (MATH 2402 or MATH 4305)
Metric spaces, normed linear spaces, convexity, and separation; polyhedra and simplicial complexes; surfaces; Brouwer fixed point theorem.

MATH 6121. Algebra I
3-0-3. Prerequisite(s): MATH 4107 and (MATH 2402 or MATH 4305)
Graduate-level linear and abstract algebra including groups, finite fields, classical matrix groups and bilinear forms, multilinear algebra and matroids. First of two courses.

MATH 6122. Algebra II
3-0-3. Prerequisite(s): MATH 6121
Graduate-level linear and abstract algebra including rings, fields, modules, some algebraic number theory and Galois theory. Second of two courses.

MATH 6221. Advanced Classical Probability Theory
3-0-3. Prerequisite(s): MATH 4221
Classical introduction to probability theory including expectation, notions of convergence, laws of large numbers, independence, large deviations, conditional expectation, martingales and Markov chains.

MATH 6241. Probability I
3-0-3. Prerequisite(s): MATH 6327
Develops the probability basis requisite in modern statistical theories and stochastic processes. Topics of this course include measure and integration foundations of probability, distribution functions, convergence concepts, laws of large numbers, and central limit theory. First of two courses.

MATH 6242. Probability II
3-0-3. Prerequisite(s): MATH 6241
Develops the probability basis requisite in modern statistical theories and stochastic processes. Topics of this course include results for sums of independent random variables, Markov processes, martingales, Poisson processes, and Brownian motion. conditional probability and conditional expectation, and topics from ergodic theory. Second of two courses.

MATH 6262. Statistical Estimation
3-0-3. Prerequisite(s): MATH 4262
Basic theories of statistical estimation, including optimal estimation in finite samples and asymptotically optimal estimation. A careful mathematical treatment of the primary techniques of estimation utilized by statisticians.

MATH 6263. Testing Statistical Hypotheses
3-0-3. Prerequisite(s): MATH 4262
Basic theories of testing statistical hypotheses, including a thorough treatment of testing in exponential class families. A careful mathematical treatment of the primary techniques of hypothesis testing utilized by statisticians.

MATH 6266. Linear Statistical Models
3-0-3. Prerequisite(s): MATH 4215
Basic unifying theory underlying techniques of regression, analysis of variance and covariance, from a geometric point of view. Modern computational capabilities are exploited fully. Students apply the theory to real data through canned and coded programs.

MATH 6267. Multivariate Statistical Analysis
3-0-3. Prerequisite(s): MATH 4262
Multivariate normal distribution theory, correlation and dependence analysis, regression and prediction, dimension-reduction methods, sampling distributions and related inference problems, selected applications in classification theory, multivariate process control, and pattern recognition.

MATH 6300. Fractal Geometry
3-0-3. Prerequisite(s): MATH 6327
Hausdorff dimension, box counting dimension, iterated function systems, continued fractions, number theory, Julia sets.

MATH 6307. Ordinary Differential Equations I
3-0-3. Prerequisite(s): MATH 4542
This sequence develops the qualitative theory for systems of ordinary differential equations. Topics include stability, Lyapunov functions, Floquet theory, attractors, invariant manifolds, bifurcation theory, normal forms. First of two courses.

MATH 6308. Ordinary Differential Equations II
3-0-3. Prerequisite(s): MATH 6307
This sequence develops the qualitative theory for systems of differential equations. Topics include stability, Lyapunov functions, Floquet theory, attractors, invariant manifolds, bifurcation theory, and normal forms. Second of two courses.

MATH 6321. Complex Analysis
3-0-3. Prerequisite(s): MATH 4317 and MATH 4320
Complex integration, including Goursat's theorem; classification of singularities, the argument principle, the maximum principle; Riemann Mapping theorem; analytic continuation and Riemann surfaces; range of an analytic function, including Picard's theorem.

MATH 6327. Real Analysis
3-0-3. Prerequisite(s): MATH 4318
Measure and integration theory. Topics include measurable functions, Lebesgue integration on R^n, general measure spaces, differentiation on R^n, functions of bounded variation, and Lp-spaces.

MATH 6328. Introduction to Functional Analysis
3-0-3. Prerequisite(s): MATH 6327
Introduction to functional analysis. Basic topics include the Hahn-Banach theorems, the Baire Category theorem and its consequences, duality in Banach spaces, distributions, Fourier transforms and applications to differential equations.

MATH 6341. Partial Differential Equations I
3-0-3. Prerequisite(s): MATH 4318
Introduction to the mathematical theory of partial differential equations covering the basic linear models of science and exact solution techniques.

MATH 6342. Partial Differential Equations II
3-0-3. Prerequisite(s): MATH 6341
This course covers the general mathematical theory of linear stationary and evolution problems plus selected topics chosen from the instructor's interests.

MATH 6441. Algebraic Topology I
3-0-3. Prerequisite(s): MATH 4107 and (MATH 4331 or MATH 6451)
Simplicial homology. Chain complexes and acyclic carriers. Simplicial approximation. The exact homology sequence. Maps of spheres. Mayer-Vietoris sequence.

MATH 6442. Algebraic Topology II
3-0-3. Prerequisite(s): MATH 6441
Continuation of MATH 6441 Singular homology. Local homology and manifolds. CW complexes. Cohomology. Duality in manifolds.

MATH 6451. General Topology
3-0-3. Prerequisite(s): MATH 4317 or MATH 4431
Introduction to topological and metric spaces. Continuity, compactness, convergence, completion. Product and quotient spaces. Elementary homotopy.

MATH 6452. Differential Topology
3-0-3. Prerequisite(s): MATH 4431 or MATH 6451
Manifolds. Differentiable structures. Tangent bundles. Embeddings and immersions. Maps on manifolds. Transversality. Morse-Sard Theorem. Vector bundles.

MATH 6514. Industrial Mathematics I
3-0-3. Prerequisite(s): (MATH 2403 or MATH 2602) and MATH 4640
Applied mathematics techniques to solve real-world problems. Topics include mathematical modeling, asymptotic analysis, differential equations, and scientific computation. Prepares the student for MATH 6515.

MATH 6515. Industrial Mathematics II
3-0-3. Prerequisite(s): MATH 6514
Applications of mathematical techniques from MATH 6514 to solve real-world problems. Group projects to solve industrial problems in topics chosen by the instructor

MATH 6580. Introduction to Hilbert Spaces
3-0-3. Prerequisite(s): MATH 2403 and (MATH 2402 or MATH 4305)
Geometry, convergence, and structure of linear operators in infinite dimensional spaces. Applications to science and engineering, including integral equations and ordinary partial differential equations.

MATH 6583. Integral Equations and Transforms
3-0-3. Prerequisite(s): MATH 6701 or (MATH 2402 and MATH 2403) or (MATH 2403 and MATH 4305)
Volterra and Fredholm linear integral equations, relation to differential equations, solution methods, Fourier, Laplace and Mellin transforms, applications to boundary value problems and integral equations.

MATH 6584. Special Functions of Higher Mathematics
3-0-3. Prerequisite(s): MATH 4320
Gamma function, exponential function, orthogonal polynomials, Bessel, Legendre and hypergeometric functions, application to singular ordinary differential equations and separation of variables for partial differential equations.

MATH 6640. Introduction to Numerical Methods for Partial Differential Equations
3-0-3.
Introduction to the implementation and analysis of numerical algorithms for the numerical solution of the classic partial differential equations of science and engineering. Must have knowledge of a computer programming language, familiarity with partial differential equations and elements of scientific computing.

MATH 6641. Advanced Numerical Methods for Partial Differential Equations
3-0-3.
Analysis and implementation of numerical methods for nonlinear partial differential equations including elliptic, hyperbolic, and/or parabolic problems. Must have knowledge of classic linear partial differential equations and exposure to numerical methods for partial differential equations at the level of MATH 6640 or numerical linear algebra at the level of MATH 6643.

MATH 6643. Numerical Linear Algebra
3-0-3. Prerequisite(s): MATH 2402 or MATH 4305
Introduction to the numerical solution of the classic problems of linear algebra including linear systems, least squares, singular value decomposition, eigenvalue problems.

MATH 6644. Iterative Methods for Systems of Equations
3-0-3. Prerequisite(s) MATH 2402 or MATH 4305
Iterative methods for linear and nonlinear systems of equations including Jacobi, G-S, SOR, CG, multigrid, Newton quasi-Newton, updating, and gradient-based methods.

MATH 6645. Numerical Approximation Theory
3-0-3. Prerequisite(s): MATH 4317
Theoretical and computational aspects of polynomial, rational, trigonometric, spline, and wavelet approximation.

MATH 6646. Numerical Methods for Ordinary Differential Equations
3-0-3. Prerequisite(s): MATH 2403 and MATH 4317
Analysis and implementation of numerical methods for initial and two-point boundary value problems for ordinary differential equations.

MATH 6647. Numerical Methods for Dynamical Systems
3-0-3.
Approximation of the dynamical structure of a differential equation and preservation of dynamical structure under discretization. Must be familiar with dynamical systems and numerical methods for initial and boundary value problems in ordinary differential equations.

MATH 6701. Math Methods of Applied Sciences I
3-0-3. Prerequisite(s): MATH 2403 and (MATH 2402 or MATH 4305)
Review of linear algebra and ordinary differential equations, brief introduction to functions of a complex variable.

MATH 6702. Math Methods of Applied Sciences II
3-0-3. Prerequisite(s): MATH 6701 or (MATH 2402 and MATH 2403) or (MATH 2403 and MATH 4305)
Review of vector calculus and its applications to partial differential equations.

MATH 6761. Stochastic Processes I
3-0-3. Prerequisite(s): MATH 4215
Discrete time Markov chains, Poisson processes and renewal processes. Transient and limiting behavior. Average cost and utility measures of systems. Algorithms for computing performance measures. Modeling of inventories, and flows in manufacturing and computer networks. Crosslisted with ISYE 6761.

MATH 6762. Stochastic Processes II
3-0-3. Prerequisite(s): MATH 6761 or ISYE 6761
Continuous time Markov chains. Uniformization, transient and limiting behavior. Brownian motion and martingales. Optional sampling and convergence. Modeling of inventories, finance, flows in manufacturing and computer networks. Crosslisted with ISYE 6762

MATH 6781. Reliability Theory
3-0-3. Prerequisite(s): MATH 4215
Reliability systems and related distributions, failure rate functions and nonparametric classes, accelerated life testing, dependent failure analysis, statistical inference of reliability data. Crosslisted with ISYE 6781.

MATH 7000. Master's Thesis
Credit hours to be arranged.

MATH 7012. Enumerative Combinatorics
3-0-3. Prerequisite(s). MATH 4032
Fundamental methods of enumeration and asymptotic analysis, including the use of inclusion/exclusion, generating functions, and recurrence relations. Applications to strings over a finite alphabet and graphs.

MATH 7016. Combinatorics
3-0-3. Prerequisite(s): MATH 4022
Fundamental combinatorial structures including hypergraphs, transversal sets, colorings, Sperner families, intersecting families, packings and coverings, perfect graphs, and Ramsey theory. Algebraic and topological methods, applications.

MATH 7018. Probabilistic Methods in Combinatorics
3-0-3. Prerequisite(s): MATH 4022 and MATH 6221
Applications of probabilistic techniques in discrete mathematics, including classical ideas using expectation and variance as well as modern tools, such as martingale and correlation inequalities.

MATH 7244. Stochastic Processes and Stochastic Calculus I
3-0-3. Prerequisite(s): MATH 6242
An introduction to the Ito stochastic calculus and stochastic differential equations through a development of continuous-time martingales and Markov processes. First of two courses.

MATH 7245. Stochastic Processes and Stochastic Calculus II
3-0-3. Prerequisite(s): MATH 7244
An introduction to the Ito stochastic calculus and stochastic differential equations through a development of continuous-time martingales and Markov processes. Continuation of MATH 7244.

MATH 7334. Operator Theory
3-0-3. Prerequisite(s): MATH 6327
Theory of linear operators on Hilbert space. Spectral theory of bounded and unbounded operators. Applications.

MATH 7337. Harmonic Analysis
3-0-3. Prerequisite(s): MATH 6327
Fourier analysis in Euclidean space. Basic topics including L^1 and L^2 theory; advanced topics such as distribution theory, uncertainty, Littlewood-Paley theory.

MATH 7581. Calculus of Variations
3-0-3. Prerequisite(s): MATH 2403
Minimization of functionals, Euler-Lagrange equations, sufficient conditions for a minimum; geodesic, isoperimetric, and time of transit problems, variational principles of mechanics, applications to control theory.

MATH 7586. Tensor Analysis
3-0-3. Prerequisite(s): MATH 2403 and (MATH 2402 or MATH 4305)
Review of linear algebra, multilinear algebra, algebra of tensors, co- and cotravariant tensors, tensors in Riemann spaces, geometrical interpretation of skew tensors.

MATH 7999. Preparation for Doctoral Comprehensive Examination
Credit hours to be arranged.

MATH 8800. Special Topics
3-0-3.
This course enables the School of Mathematics to comply with requests for courses in selected topics.

MATH 8801,-2,-3,-4,-5. Special Topics
Credit and class hours equal last digit of course number.
This course enables the School of Mathematics to comply with requests for courses in selected topics.

MATH 8810. Special Topics
3-0-3.
This course enables the School of Mathematics to comply with requests for courses in selected topics.

MATH 8811,-2,-3,-4,-5. Special Topics
Credit and class hours equal last digit of course number.
This course enables the School of Mathematics to comply with requests for courses in selected topics.

MATH 8820. Special Topics
3-0-3.
This course enables the School of Mathematics to comply with requests for courses in selected topics.

MATH 8821,-2,-3,-4,-5. Special Topics
Credit and class hours equal last digit of course number.
This course enables the School of Mathematics to comply with requests for courses in selected topics.

MATH 8830. Special Topics
3-0-3.
This course enables the School of Mathematics to comply with requests for courses in selected topics.

MATH 8831,-2,-3,-4,-5. Special Topics
Credit and class hours equal last digit of course number.
This course enables the School of Mathematics to comply with requests for courses in selected topics.

MATH 8840. Special Topics
3-0-3.
This course enables the School of Mathematics to comply with requests for courses in selected topics.

MATH 8841,-2,-3,-4,-5. Special Topics
Credit and class hours equal last digit of course number.
This course enables the School of Mathematics to comply with requests for courses in selected topics.

MATH 8850. Special Topics
3-0-3.
This course enables the School of Mathematics to comply with requests for courses in selected topics.

MATH 8851,-2,-3,-4,-5. Special Topics
Credit and class hours equal last digit of course number.
This course enables the School of Mathematics to comply with requests for courses in selected topics.

MATH 8900,-1,-2,-3. Special Problems
Credit hours to be arranged.

MATH 8997. Teaching Assistantship
Credit hours to be arranged.
For students holding graduate teaching assistantships.

MATH 8998. Research Assistantship
Credit hours to be arranged.
For students holding graduate research assistantships.

MATH 9000. Doctoral Thesis
Credit hours to be arranged.

School of Physics

Established in 1939
Location: Howey Building
Telephone: (404) 894-5201
Fax: (404) 894-9958
Website: www.physics.gatech.edu

Chair and Professor–Rajarshi Roy; *Associate Chair for Graduate Programs*–Ronald Fox; *Associate Chair for Undergraduate Programs and Professor*–Henry Valk; *Callaway Chair and Regents' Professor*–Uzi Landman; *Georgia Research Alliance-Lucent Eminent Scholar Chair*–Rick Trebino; *Regents' Professors*–Martin R. Flannery, Ronald Fox; *Professors*–Mei-Yin Chou, Walt deHeer, William Ditto, Ahmet Erbil, David Finkelstein, Ian Gatland, James Gole, Donald O'Shea, Eugene Patronis, Edward Thomas, Turgay Uzer, Robert Whetten, Kurt Wiesenfeld, John Wood, Andrew Zangwill; *Associate Professors*–Edward Conrad, Phillip First, M. Brain Kennedy; *Assistant Professors*–Michael Chapman, Carlos Sa de Melo, Michael Schatz, Li You; *Senior Research Scientists*–Robert Barnett, Edward Bogachek, Charles Cleveland, Jianping Gao, William Luedtke, Constantine Yannouleas; *Research Scientists II*–Andrew Scherbakov, Robert Sudduth; *Adjunct Faculty*–Akit Balentekin, Fred Eisele, Piara Gill, James Sowell, Christopher Summers, Richard Williamson.

General Information

Physics is primarily a basic science, and fundamental research into the principles of physics continues to occupy the attention of many physicists. The study of physics has also become increasingly important as a basis for fundamental research in interdisciplinary areas such as biophysics and chemical physics and as an applied science in government and industry. Furthermore, as society becomes more technically oriented, an education in physics can provide an advantageous preprofessional foundation.

The School of Physics offers basic service courses to freshmen and sophomores, some advanced service courses for students in other units of the Institute, and advanced studies leading to the bachelor's, master's, and Ph.D. degrees in physics. The School seeks to provide elective freedom in its degree programs in order to enable students with a wide variety of goals to construct programs of study suitable for them.

In addition to offering courses in the fundamentals of physics, the School provides numerous specialized courses at all levels, particularly in those areas related to the research interests of the faculty. These areas of research currently include: acoustics; atomic, molecular, and chemical physics; biophysics; computational materials science; nonlinear mechanics and chaos; nuclear and particle physics; optics and laser physics; condensed matter physics; quantum logic; relativity; statistical mechanics; physics instruction; and interdisciplinary areas of biophysics and materials science. Opportunities exist in all these areas and in other areas through collaboration with faculty of other schools and colleges, for special problem courses, master's theses, and doctoral dissertations.

Program planning information supplementary to this catalog is available from the School of Physics. A brochure further describing the opportunities for graduate study and research is also available upon request.

Undergraduate Program

The School of Physics offers two undergraduate degrees, the Bachelor of Science in Physics and the Bachelor of Science in Applied Physics. The basis of the former degree is the traditional preparation of a student for graduate study in physics.

The degree program in applied physics may be better suited for entry into industry or government upon graduation, preparation for further professional training (medicine, law, dentistry, or business), or preparation for graduate study in some other discipline. The applied physics program differs from the traditional one in that a few courses intended primarily as preparation for graduate study in physics are replaced by courses oriented toward the applications of physics.

Each of the baccalaureate programs contains the following: (a) courses needed to meet general institutional degree requirements; (b) a core of technical courses intended to give a strong background in mathematics and the physical principles of mechanics, electricity and magnetism, thermodynamics, and the quantum theory that governs physical phenomena at the microscopic level of molecules, atoms, and nuclei; (c) technical electives that enable the student to explore areas of his or her choice in greater depth; and (d) free electives, about 15 percent of the total hours, which may be employed to schedule additional technical or nontechnical courses.

The considerable flexibility inherent in the physics curricula is advantageous to students who wish to work out individual programs of study. At the same time, this flexibility suggests the need for consultation with advisors so students can make the best use of elective hours and avoid scheduling difficulties that may arise in later semesters. Students may utilize their elective freedom in the physics curricula to specialize in particular areas of physics, to prepare for careers in interdisciplinary areas of science, to compose a preprofessional program, or to gain a background in other technical or nontechnical disciplines. To assist students in planning programs of study with emphasis directed toward a particular objective, the School has formulated suggestions for the use of elective hours. Supplementary materials, available from the School office or from faculty advisors, include suggestions relevant to the following areas of study: preparation for graduate study in physics; acoustics; applied optics; atomic, molecular, and chemical physics; biophysics; computational physics; computer-based instrumentation; nonlinear dynamics and chaos; solid state physics, and preparation for teaching secondary education. Attention is also directed to the possibility of using elective hours for special problems (PHYS 3900-1-2 or 4900-1-2) conducted under the supervision of a faculty member.

Since some students who earn a degree in physics have transferred from other disciplines, the School has planned its degree programs to enable most students to transfer into physics with little or no loss of credit.

A total of 120 credit hours (exclusive of wellness) and a grade point average of at least 2.0 in physics courses numbered 3000 and higher are requisites for the bachelor's degree in physics.

Certificate Program in Physics

The School of Physics offers a program of study leading to a certificate in Applied Optics. The purpose of this program is to prepare students for a career in industry where basic physical understanding is applied to the solution of technological problems. Course requirements, which are fulfilled in the junior and senior years, are detailed in brochures available from the School.

Bachelor of Science in Physics (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
CHEM 1211	CHEMISTRY I	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		14

First Year - Spring Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
PHYS 2211	PHYSICS I	4
CS 1301	COMPUTER SCIENCE I	3
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS		16

Second Year - Fall Semester

Course Number/Name		*Hours*
MATH 2401	CALCULUS III	4
PHYS 2212	PHYSICS II	4
SOCIAL SCIENCE ELECTIVES		6
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		17

Second Year - Spring Semester

Course Number/Name		Hours
MATH 2403	DIFFERENTIAL EQUATIONS	4
PHYS 2133	INTRO TO MODERN PHYSICS	3
PHYS 3201	CLASSICAL MECHANICS I	3
SOCIAL SCIENCE ELECTIVE		3
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		16

Third Year - Fall Semester

Course Number/Name		Hours
PHYS 3143	QUANTUM MECHANICS I	3
PHYS 3122	ELECTROSTATICS & MAGNET	3
PHYSICS or TECHNICAL ELECTIVES		6
FREE ELECTIVE		3
TOTAL SEMESTER HOURS		15

Third Year - Spring Semester

Course Number/Name		Hours
PHYS 3141	THERMODYNAMICS	3
PHYS 3123	ELECTRODYNAMICS	3
PHYSICS or TECHNICAL ELECTIVES		3
FREE ELECTIVES		6
TOTAL SEMESTER HOURS		15

Fourth Year - Fall Semester

Course Number/Name		Hours
PHYS 4321	ADVANCED LAB I	3
PHYS 4142	STATISTICAL MECHANICS	3
PHYSICS or TECHNICAL ELECTIVE		3
PHYS 4601	SENIOR SEMINAR I	1
FREE ELECTIVES		5
TOTAL SEMESTER HOURS		15

Fourth Year - Spring Semester

Course Number/Name		Hours
PHYS 4143	QUANTUM MECHANICS II	3
PHYS 4602	SENIOR SEMINAR II	1
PHYSICS or TECHNICAL ELECTIVES		5
FREE ELECTIVES		5
TOTAL SEMESTER HOURS		14

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Bachelor of Science in Applied Physics (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		Hours
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
CHEM 1211	CHEMISTRY I	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
TOTAL SEMESTER HOURS		14

First Year - Spring Semester

Course Number/Name		Hours
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
PHYS 2211	PHYSICS I	4
CS 1301	COMPUTER SCIENCE I	3
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS		16

Second Year - Fall Semester

Course Number/Name		Hours
MATH 2401	CALCULUS III	4
PHYS 2212	PHYSICS II	4
SOCIAL SCIENCE ELECTIVES		6
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		17

Second Year - Spring Semester

Course Number/Name		Hours
MATH 2403	DIFFERENTIAL EQUATIONS	4
PHYS 2133	INTRO. TO MODERN PHYSICS	3
PHYS 3201	CLASSICAL MECHANICS I	3
SOCIAL SCIENCE ELECTIVE		3
HUMANITIES ELECTIVE		3
TOTAL SEMESTER HOURS		16

Third Year - Fall Semester

Course Number/Name		Hours
PHYS 3143	QUANTUM MECHANICS I	3
PHYS 3122	ELECTROSTATICS & MAGNET	3
PHYSICS or TECHNICAL ELECTIVE		3
PHYS 3266	COMPUTATIONAL PHYSICS	4
FREE ELECTIVE		3
TOTAL SEMESTER HOURS		16

Third Year - Spring Semester

Course Number/Name		*Hours*
PHYS 3141	THERMODYNAMICS	3
PHYS 3123	ELECTRODYNAMICS	3
PHYSICS or TECHNICAL ELECTIVE		3
FREE ELECTIVE		5
TOTAL SEMESTER HOURS		14

Fourth Year - Fall Semester

Course Number/Name		*Hours*
PHYS 4321	ADVANCED LAB I	3
PHYS 3211	ELECTRONICS I	4
PHYS 4601	SENIOR SEMINAR I	1
PHYSICS or TECHNICAL ELECTIVE		3
FREE ELECTIVE		3
TOTAL SEMESTER HOURS		14

Fourth Year - Spring Semester

Course Number/Name		*Hours*
PHYS 4206	ELECTRONICS II	4
PHYSICS or TECHNICAL ELECTIVE		5
PHYS 4602	SENIOR SEMINAR II	1
FREE ELECTIVES		5
TOTAL SEMESTER HOURS		15

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Electives

Humanities and Social Sciences

Students whose scores are sufficiently high on the College Board SAT Verbal and the English achievement examinations may, in consultation with the School of Literature, Communication, and Culture, replace ENGL 1001 or 1002 with other English courses.

All students are required to pass examinations or courses in the history and constitutions of the United States and Georgia. HIST 2111, HIST 2112, POL 1101, PUBP 3000, or INTA 1200 fulfill this requirement.

See "Information for Undergraduate Students" (pages 33-34) for additional information relative to the 24 credit-hour requirement in the humanities and the social sciences.

Physics

Students who have demonstrated competence in mathematics are encouraged to substitute the honors sequence PHYS 2131-2 for PHYS 2211-2.

Graduate Programs

Master's Programs

The School of Physics offers two master's degrees: the Master of Science in Physics and the Master of Science in Applied Physics.

The Master of Science in Physics is the traditional physics degree and normally comprises the program a graduate student follows in the initial course of study toward a doctorate. Students may fulfill the requirements by taking 30 hours of course work or by electing a master's thesis in lieu of 6 hours of course work.

The School of Physics recommends that most programs include:

First Semester

- PHYS 6101 Classical Mechanics I (3)
- PHYS 6103 Electromagnetism I (3)
- PHYS 6105 Quantum Mechanics I (3)
- PHYS 6124 Mathematical Methods of Physics I (3)

Second Semester

- PHYS 6107 Statistical Mechanics (3)
- PHYS 6104 Electromagnetism II (3)
- PHYS 6105 Quantum Mechanics II (3)
- PHYS 6125 Mathematical Methods of Physics II (3)

A minimum of 30 course hours are required, of which at least 18 hours must be in physics. For the thesis option, 6 hours in the major field may be replaced by 6 hours of thesis work. At least 12 of the course hours must be at the graduate level (6000 level or greater) if a thesis is elected. Otherwise, at least 21 course hours at the graduate level must be taken.

The Master of Science in Applied Physics is intended to prepare an individual for a career in industrial, independent, or government laboratories. It is a good choice as a terminal master's degree.

In most cases an area of concentration such as acoustics or optics is chosen. It is then usual to select technical electives related to that area.

The School of Physics recommends that most programs include:

First Semester
- PHYS 6202 Applied Electricity and Magnetism (3)
- PHYS 6204 Analog or Digital Electronics (4)
- Technical elective in an area of concentration (5)

Second Semester
- PHYS 6201 Applied Quantum Mechanics (3)
- PHYS 6203 Solid State Physics (3)
- Technical electives in an area of concentration (4)
- PHYS 8991-8993 Practicum or PHYS 7000 Thesis (2)

Third Semester
- PHYS 8991-8993 Practicum or PHYS 7000 Thesis (4)

Doctoral Program

This degree program comprises recommended course work in fundamental physics, the successful completion of the School's comprehensive examination, four required courses in advanced physics, and an independent research investigation that culminates in the Ph.D. thesis. The Institute additionally mandates that nine credit hours be earned in a "minor" field that differs from the discipline of physics of the Ph.D. investigation.

In preparation for the comprehensive examination, the School recommends that the first year of graduate study be devoted to course work as follows:

First Semester
- PHYS 6101 Classical Mechanics I (3)
- PHYS 6103 Electromagnetism I (3)
- PHYS 6105 Quantum Mechanics I (3)
- PHYS 6124 Mathematical Methods of Physics I (3)

Second Semester
- PHYS 6107 Statistical Mechanics I (3)
- PHYS 6104 Electromagnetism II (3)
- PHYS 6106 Quantum Mechanics II (3)
- PHYS 6125 Mathematical Methods of Physics II (3)

The four required courses in advanced physics must be chosen from those with course numbers in the interval 7001-7699. These may be taken at any time and may not be used to satisfy the Institute's "minor" requirement.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

PHYSICS

PHYS 1000. Physics Orientation
1-0-1.
Guest lectures will describe career opportunities in physics, the role physicists play in education, government, and industrial laboratories, and programs available to physics majors.

PHYS 2001. Evolution of Physics
2-0-2. Prerequisite(s): PHYS 2211
The development of physics concepts and doctrines from early times to the the near future, with social and philosophical correlates.

PHYS 2021. The Solar System
3-0-3.
This course covers Ancient and Renaissance astronomy, gravity, sky phenomena, telescopes, and the solar system.

PHYS 2022. Stars, Galaxies, and the Universe
3-0-3.
This course covers optics, telescopes, stellar characteristics and evolution, galaxies, the universe, and the big bang. Physics topics include mechanics, optics, atomic, nuclear, and relativity.

PHYS 2030. Physics of Music
2-0-2.
An introduction to the physical principles underlying the production, transmission, and detection of musical sounds.

PHYS 2133. Introduction to Modern Physics
3-0-3. Prerequisite(s): PHYS 2212 or PHYS 2232
A survey of 20th century physics. Developments of several branches of physics up to their present frontiers, including historical and philosophical perspectives.

PHYS 2211. Introductory Physics I
3-4-4. Co-requisite: MATH 2401.
One- and two-dimensional motion of particles in gravitational and electric fields. Calculations of fields from the underlying force laws. Concepts of energy and potential.

PHYS 2212. Introductory Physics II
3-3-4. Prerequisite(s): PHYS 2211 and MATH 2401
Magnetism and Maxwell's equations. Mechanical waves. Electromagnetic waves and quantum mechanics. Introduction to nuclear phenomena, quantum tunneling, and relativity.

PHYS 2231. Honors Physics I
4-3-5. Co-requisite: MATH 2401.
Parallels introductory Physics I (PHYS 2211). Some topics treated in more depth or more extensively. A rigorous physics foundation requiring demonstrated competence in mathematics.

PHYS 2232. Honors Physics II
4-3-5. Prerequisite(s): PHYS 2231 and MATH 2401
Parallels introductory Physics II (PHYS 2212). Some topics treated in more depth or more extensively. No modern physics content. A rigorous physics foundation requiring demonstrated competence in mathematics.

PHYS 2750. Physics of the Weather
3-0-3. Prerequisite(s): PHYS 2212
An introductory treatment of applying basic physical laws to understanding weather phenomena. Crosslisted with EAS 2750.

PHYS 2801,-2,-3,-4. Special Topics
Credit and class hours equal last digit of course number.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 2900,-1,-2. Special Problems
Credit hours to be arranged.
Course involving special problems in physics are offered from time to time.

PHYS 3021. Stellar Astrophysics
3-0-3. Prerequisite(s): PHYS 2212 or PHYS 2232
Develops a working knowledge of stellar and extra-stellar galactic astronomy. Includes stellar structure, nucleosynthesis, stellar evolution, and degenerate objects.

PHYS 3043. Wave Mechanics
3-0-3. Prerequisite(s): PHYS 2212
A first introduction to wave mechanics, with emphasis on practical calculations. The rules of quantum mechanics will be illustrated by many working examples.

PHYS 3122. Electrostatics and Magnetostatics
3-0-3. Prerequisite(s): PHYS 2212 or PHYS 2232; Co-requisite: MATH 2403.
First of two courses on the physics of electromagnetism. Topics include Coulomb's Law, Ampere's Law, scalar and vector potentials. Laplace's equation and static and magnetic fields in matter.

PHYS 3123. Electrodynamics
3-0-3. Prerequisite(s): PHYS 3122; Co-requisite: MATH 2403.
Second of two courses on the physics of electromagnetism. Topics include time-dependent phenomena including Faraday's Law, the Maxwell equations, electromagnetic radiation, and electromagnetic waves.

PHYS 3141. Thermodynamics
3-0-3. Prerequisite(s): PHYS 2212 or PHYS 2232; Co-requisite: MATH 2403.
Introduction to the basic concepts of thermodynamics. Thermodynamic laws will be developed with an emphasis on the macroscopic point of view. Applications of the basic principles will be considered briefly.

PHYS 3143. Quantum Mechanics I
3-0-3. Prerequisite(s): PHYS 2211; Co-requisite: MATH 2403.
First of two courses that develop the principles of quantum mechanics. Topics include the state vector concept. Heisenberg and Schrodinger pictures, uncertainty relations, and exact solvable models in one dimension.

PHYS 3151. Mathematical Physics
3-0-3. Prerequisite(s): MATH 2402 and PHYS 2212
A review of the mathematical techniques required for the description of physical systems encountered in mechanics, electromagnetism, thermal physics, and quantum mechanics.

PHYS 3201. Classical Mechanics I
3-0-3. Prerequisite(s): PHYS 2232; Co-requisite: MATH 2403.
Dynamics of particles including oscillations and planetary motion, rotation of rigid bodies, and collisions.

PHYS 3202. Classical Mechanics II
3-0-3. Prerequisite(s): PHYS 3201
A continuation of PHYS 3201. Topics include Lagrangians and Hamiltonian techniques, and many body mechanics.

PHYS 3211. Electronics I
3-6-4. Prerequisite(s): PHYS 2212 or PHYS 2232
A first course in both theoretical and applied electronics that is based on a thorough grounding in circuit as well as device physics.

PHYS 3223. Geometrical Optics and Lens Design
3-0-3. Prerequisite(s): PHYS 2212 and MATH 2402
Principles of geometrical optics using ray tracing techniques. Stops, pupils, aberrations, and photometry. Design and analysis of lenses using current lens design software.

PHYS 3224. Geometrical Optics Laboratory
1-3-2. Prerequisite(s): PHYS 3223
Measurement of parameters of optical surfaces, lenses, and systems using a variety of techniques.

PHYS 3225. Modern Optics
3-0-3. Prerequisite(s): PHYS 2212 and MATH 2402
Principles of wave propagation, coherence, polarization, diffraction, and Fourier Optics, laser theory including the interaction of light with matter.

PHYS 3226. Modern Optics Laboratory
1-3-2. Prerequisite(s): PHYS 3225
Measurement of parameters of optical surfaces, lenses, and systems using a variety of modern optics techniques.

PHYS 3265. Acoustics
3-0-3. Prerequisite(s): PHYS 2212
A course in classical acoustics and applied electroacoustics taught through the palliative of a study of sound reinforcement and reproduction systems.

PHYS 3266. Computational Physics
3-3-4. Prerequisite(s): PHYS 2212 or PHYS 2232
Computer solutions of realistic physics problems such as projectiles in resistive media, electromagnetic sources and fields, atomic scattering, and band pass filters.

PHYS 3801,-2,-3,-4. Special Topics
Credit and class hours equal last digit of course number.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 3900,-1,-2. Special Problems
Credit hours to be arranged.
Courses involving special problems in physics are offered from time to time.

PHYS 4142. Statistical Mechanics
3-0-3. Prerequisite(s): PHYS 2133 and PHYS 3143
The statistical basis of thermodynamics is developed. Topics include entropy and the second law, partition functions and free energy, systems of variable particle number, and quantum statistics.

PHYS 4143. Quantum Mechanics II
3-0-3. Prerequisite(s): PHYS 3143
Second of two courses that develop the principles of quantum mechanics. Topics include angular momentum, hydrogen atom, variation methods, perturbation theory, matter-radiation interactions, identical particles.

PHYS 4146. Special Relativity
3-0-3. Prerequisite(s): PHYS 3123
The unification of space and time emerging from the physics of light, and its experimental and theoretical consequences.

PHYS 4206. Electronics II
3-6-4. Prerequisite(s): PHYS 3211
A course in electronic instrumentation with an emphasis on signal processing, both analog and digital, and computer interfacing.

PHYS 4220. Optical Design
3-0-3. Prerequisite(s): PHYS 3223
Principles of optical and optomechanical design including tolerancing, specification, and thermal compensation of systems.

PHYS 4222. Solid State Devices
3-0-3. Prerequisite(s): PHYS 3141 and PHYS 3143
Course provides an understanding of contemporary research on solid state devices. Topics include band structure, p-n junctions, transistors, superlattices, lasers and detectors, charge coupled devices, and others.

PHYS 4251. Biophysics
3-0-3. Prerequisite(s): PHYS 2212 and BIOL 1510
Physical principles applied to molecular and cellular biology. Topics include chemiosmosis, self-assembly, protein biosynthesis, and the mechanisms of muscle and nerve function.

PHYS 4261. Atomic Physics
3-0-3. Prerequisite(s): PHYS 4143
Course provides an introduction to the fundamentals of atomic physics, the structure of atoms, and their interaction with static and radiation fields.

PHYS 4262. Solid State Physics
3-0-3. Prerequisite(s): PHYS 3143
A first course in the physics of crystalline solids. Core topics include crystal lattices, diffraction, bonding, elastic properties, band theory, as well as others.

PHYS 4263. Nuclei, Particles, and Fields
3-0-3. Prerequisite(s): PHYS 3143
An introduction to nuclear and subnuclear systems. Topics include nuclear models, radioactive decay, nuclear reactions, quarks, accelerators, reactors, and stellar nucleosynthesis.

PHYS 4267. Nonlinear Dynamics and Chaos
3-0-3. Prerequisite(s): PHYS 3201
A modern introduction to nonlinear phenomena. Topics include driven oscillators, entrainment, bifurcation, fractals, and control of chaos. Examples are drawn from physical systems.

PHYS 4321. Advanced Laboratory I
1-6-3. Prerequisite(s): PHYS 3143
Experiments are conducted that demonstrate basic principles from various fields of physics. An emphasis is placed on contemporary concepts in modern physics.

PHYS 4322. Advanced Laboratory II
1-6-3. Prerequisite(s): PHYS 4321
A continuation of PHYS 4321. Experiments are conducted that demonstrate basic principles from various fields of physics. An emphasis is placed on contemporary concepts in modern physics.

PHYS 4421. Introduction to Continuum Physics
3-0-3. Prerequisite(s): PHYS 3201
A modern introduction to continuum physics. Topics include elastic theory, dislocations and waves, fluid mechanics and dynamics, and instabilities in fluids.

PHYS 4601,-2. Senior Seminar I,-II
1-0-1, each.
Representative research programs in the School are described by advanced graduate students, post-doctorals, and faculty members.

PHYS 4655. Introductory Diffraction Studies
2-6-4.
Introductory theory and practice of x-ray and neutron diffraction techniques, including single crystals and powders. Laboratory work is strongly correlated with principles developed in the lectures.

PHYS 4751. Laser Theory and Applications
3-0-3. Prerequisite(s): PHYS 2212
Provides an introduction to the theory and applications of laser principles and related instrumentation. Emphasis is on the fundamental principles underlying laser action. Crosslisted with ECE 4751.

PHYS 4801,-2,-3,-4. Special Topics
Credit and class hours equal last digit of course number.
Courses in special topics of current interest in physics are presented from time to time.

PHYS 4900,-1,-2. Special Problems
Credit hours to be arranged.
Courses involving special problems in physics are offered from time to time.

PHYS 6011. Nuclear and Particle Physics
3-0-3.
Quantum mechanics of nuclear and subnuclear systems. Topics include shell, collective, and pairing models; multi-quark systems; group theoretical and dynamic algebra techniques.

PHYS 6101. Classical Mechanics I
3-0-3.
Newtonian mechanics, Hamilton's variational principle, Lagrangian and Hamiltonian mechanics, central forces, rigid body motion, and small oscillations.

PHYS 6102. Classical Mechanics II
3-0-3. Prerequisite(s): PHYS 6101
Canonical transformations, Hamilton-Jacobi theory, canonical perturbation theory, and an introduction to the Lagrangian formulations for continuous systems and fields.

PHYS 6103. Electromagnetism I
3-0-3.
Static and quasistatic phenomena in electromagnetism. Boundary value problems in electrostatics and magnetostatics. Maxwell's equations.

PHYS 6104. Electromagnetism II
3-0-3. Prerequisite(s): PHYS 6103
Theory of generation of electromagnetic waves, their propagation, scattering, and diffraction. Covariant formulation of electrodynamics and application to radiation from charged particles.

PHYS 6105. Quantum Mechanics I
3-0-3.
An axiomatic development of quantum mechanics. Topics include linear vector spaces, linear operators, infinitessimal transformations, function space, representation, and transformation groups.

PHYS 6106. Quantum Mechanics II
3-0-3. Prerequisite(s): PHYS 6105
Applications of quantum mechanics. Topics include systems with spin and angular momentum, atomic structure, time-dependent phenomena, scattering, and various methods of modeling and approximations.

PHYS 6107. Statistical Mechanics I
3-0-3.
Equilibrium statistical mechanics for closed and open systems. Probability distribution for classical and quantum systems. Partition functions and associated thermodynamical potentials.

PHYS 6110. Survey of Physics
5-0-5.
This course provides a review of basic theories in classical and quantum physics through the solution of problems. It provides an excellent preparation for students planning to take the doctoral qualifying exam. This course cannot be used for credit toward a graduate degree in physics.

PHYS 6124. Mathematical Methods of Physics I
3-0-3.
First of two courses on mathematical methods used in classical mechanics, electromagnetism, quantum mechanics, and statistical physics. Topics include complex analysis, vectors and matrices, and Sturm-Liouville theory.

PHYS 6125. Mathematical Methods of Physics II
3-0-3. Prerequisite(s): PHYS 6124
Second of two courses on mathematical methods. Topics include partial differential equations, random processes, and group theory.

PHYS 6201. Applied Quantum Mechanics
3-0-3.
Basic postulates of quantum mechanics, one-dimensional energy eigenvalue problems. Potential wells, tunneling phenomena.

PHYS 6202. Applied Electromagnetism
3-0-3.
A course centered on the solution of practical problems encountered in the transmission and reception of electromagnetic signals via transmission lines, waveguides, and radiation.

PHYS 6203. Solid State Physics
3-0-3.
A first course in the physics of crystalline solids. Core topics include crystal lattices, diffraction, bonding, elastic properties, band theory, as well as others.

PHYS 6204. Electronics I
3-6-4.
A first course in both theoretical and applied electronics that is based on a thorough grounding in circuit as well as device physics.

PHYS 6206. Electronics II
3-6-4.
A course in electronic instrumentation with an emphasis on signal processing, both analog and digital, and computer interfacing.

PHYS 6210. Condensed Matter Physics I
3-0-3. Prerequisite(s): PHYS 6101 and PHYS 6103 and PHYS 6105 and PHYS 6107
Introduction to condensed matter physics. Crystal structure, electronic and thermal properties, response to external electric and magnetic fields.

PHYS 6211. Condensed Matter Physics II
3-0-3. Prerequisite(s): PHYS 6210
Collective and many-electron properties in condensed matter systems. Topics include second quantization, magnetism, phase transitions, and superconductivity.

PHYS 6265. Atomic Physics I
3-0-3. Prerequisite(s): PHYS 4143
This course provides a detailed description of atomic structures and interactions. It contains applications of advanced quantum mechanics to problems in modern atomic physics.

PHYS 6267. Atomic Physics II
3-0-3. Prerequisite(s): PHYS 6265
This course will provide detailed descriptions of non-relativistic atomic/molecular scattering/reaction processes.

PHYS 6300. Graduate Laboratory
1-6-3.
Experiments are conducted that demonstrate basic principles from various fields of physics. An emphasis is placed on contemporary concepts in modern physics.

PHYS 6787. Quantitative Electrophysiology
3-0-3.
A quantitative presentation of electrophysiological systems in biomedical organisms, emphasizing the electrical properties and modeling of neural and cardiac cells and systems. Crosslisted with BMED and ECE 6787

PHYS 7000. Master's Thesis
Credit hours to be arranged.

PHYS 7123. Statistical Mechanics II
3-0-3. Prerequisite(s): PHYS 6107
Principles of nonequilibrium statistical mechanics, both classical and quantal. Emphasis is on the dynamics of fluctuations, their measurement and their relationship to transport properties.

PHYS 7125. Gravity
3-0-3. Prerequisite(s): PHYS 6101 and PHYS 6103
The theory of gravity, describing how matter curves spacetime and spacetime guides matter, with its experimental and theoretical applications.

PHYS 7141. Many-Particle Quantum Mechanics
3-0-3. Prerequisite(s): PHYS 6106
Quantum mechanics of interacting Fermi and Bose particles. Topics include second quantization, diagrammatic purturbation theory, variational methods, and path integrals.

PHYS 7143. Group Theory and Quantum Mechanics
3-0-3. Prerequisite(s): PHYS 6106
Foundations of group representation theory with applications in atomic, molecular, nuclear, and solid-state physics.

PHYS 7147. Quantum Field Theory
3-0-3. Prerequisite(s): PHYS 6106
Introduction to quantum field theory, with an emphasis in quantum electrodynamics. Second quantization, Dirac equation, Feynman diagrams, quantum electrodynamics, electro-weak interactions.

PHYS 7150. Quantum Logics
3-0-3. Prerequisite(s): PHYS 6106
The revision of classical logic and set theory to accommodate the phenomena of quantum interference, with experimental and theoretical consequences.

PHYS 7221. Statistical Optics
3-0-3.
Phenomena in optics where randomness is dominant. Topics include random variables and processes, partial coherence, polarization, photo statistics, and imaging in random media.

PHYS 7222. Quantum Optics I
3-0-3. Prerequisite(s): PHYS 4143 or PHYS 6106
Basic course on the interaction of light with matter, based on quantum theory. Applications to the laser and to the study of coherence properties of light.

PHYS 7223. Quantum Optics II
3-0-3. Prerequisite(s): PHYS 7222
Advanced treatment of the interaction of light with matter using modern methods of open quantum systems. Applications to current research.

PHYS 7224. Nonlinear Dynamics
3-0-3. Prerequisite(s): PHYS 6101
A course on nonlinear dissipative dynamical systems, with an emphasis on aspects relevant to physicists. Topics include bifurcation theory, attractors, renormalization group techniques, and pattern formation.

PHYS 8001,-2. Graduate Student Seminar
1-0-1, each.
Representative research programs in the School are described by advanced graduate students, post-doctorals, and faculty members. The experimental basis of physics is illustrated through accounts of great experiments of importance to contemporary research.

PHYS 8801,-2,-3,-4. Special Topics
Credit and class hours equal last digit of course number.

PHYS 8901. Special Problems
Credit hours to be arranged.

PHYS 8991,-2,-3. Master's Practicum
Credit hours to be arranged.

PHYS 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding a graduate teaching assistantship.

PHYS 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding a graduate research assistantship.

PHYS 9000. Doctoral Thesis
Credit hours to be arranged.

School of Psychology

Established in 1959
Location: Psychology Building
Telephone: (404) 894-2680/2683
Fax: (404) 894-8905
Website: www.gatech.edu/psychology

Chair and Professor–Randall Engle; *Associate Chair and Professor*–Fredda Blanchard-Fields; *Director and Professor Emeritus*–Edward H. Loveland; *Professors*–Phillip L. Ackerman, Albert N. Badre, Jack M. Feldman, Arthur D. Fisk, Christopher K. Hertzog, Ruth Kanfer, Terry L. Maple, M. Jackson Marr, Stanley A. Mulaik, M. Carr Payne Jr. (emeritus), Timothy A. Salthouse, Anderson D. Smith; *Associate Professors*–Dorrit Billman, Richard Catrambone, Elizabeth T. Davis, Todd J. Maurer, Wendy A. Rogers, Craig M. Zimring; *Assistant Professors*–Gregory Berns, Jeffrey Toth; *Instructors*–Judith Crothers-Flamming, Dianne Leader; *Adjunct Professors*–Mollie Bloomsmith, Kristin Boyle, Theodore J. Doll, Debra L. Forthman, Leonard W. Poon.

General Information

The School of Psychology offers programs of study leading to the Bachelor of Science in Applied Psychology and the Master of Science and Doctor of Philosophy in Psychology. It also offers training in the basic and applied aspects of the science of behavior for the student majoring in architecture, engineering, management, and natural sciences. The undergraduate curriculum provides a broad-based natural science approach to the study of psychology. Courses in mathematics, biology, and chemistry, for instance, complement the psychology courses. The curriculum also stresses methodological issues so that students learn the fundamentals for carrying out solid research.

Undergraduate Program

The curriculum is technically oriented and stresses quantitative and experimental approaches to the study of behavior. The undergraduate curriculum is based on a strong emphasis in the sciences and mathematics and provides an excellent preparation for graduate school in psychology, medical school, law school, and other professional and academic graduate programs. In addition, many students with the B.S. degree in psychology choose to enter a variety of fields including computer software design, human resources, marketing, human factors, system design, personnel selection and training, and management. The program includes 18 hours of free electives to provide needed flexibility for career development.

Bachelor of Science in Applied Psychology (Suggested Schedule)

First Year - Fall Semester

Course Number/Name		*Hours*
ENGL 1101	ENGLISH COMPOSITION I	3
MATH 1501	CALCULUS I	4
BIOL 1510	BIOL. PRINCIPLES	4
HIST 2111 or 2112 or POL 1101 or PUBP 3000 or INTA 1200		3
HPS 1040/1061	WELLNESS	2
TOTAL SEMESTER HOURS		16

First Year - Spring Semester

Course Number/Name		*Hours*
ENGL 1102	ENGLISH COMPOSITION II	3
MATH 1502	CALCULUS II	4
BIOL 1520	INTRO. TO ORGANISMAL BIOL.	4
CS 1301	COMPUTER SCIENCE I	3
PSYC 1101	GENERAL PSYCHOLOGY	3
TOTAL SEMESTER HOURS		17

Second Year - Fall Semester

Course Number/Name		*Hours*
LAB SCIENCE	(CHEM 1211 OR PHYS 2211)	4
MATH 2XXX	ELECTIVE	3
PSYC 2010	RESEARCH METHODS	3
PSYC 2220	INDUSTRIAL/ORGAN. PSYCHOLOGY	3
PSYC 2210	SOCIAL PSYCHOLOGY	3
TOTAL SEMESTER HOURS		16

Second Year - Spring Semester

Course Number/Name		*Hours*
LAB SCIENCE	(CHEM 1311 and 1312 or PHYS 2212)	4
PSYC 2103	HUMAN DEVELOPMENT	3
PSYC 2020	PSYCHOLOGICAL STAT.	4
PSYC 2240	PERSONALITY THEORY	3
TOTAL SEMESTER HOURS		14

Third Year - Fall Semester

Course Number/Name		*Hours*
PSYC 3020	BIOPSYCHOLOGY	3
PSYC 3010	COGNITIVE PSYCHOLOGY	3
PSYC 3015	COGNITIVE PSYCHOLOGY LAB	1
PSYC 3XXX	ELECTIVE	3
HUMANITIES ELECTIVE		3
FREE ELECTIVE		3
TOTAL SEMESTER HOURS		16

Third Year - Spring Semester

Course Number/Name		*Hours*
PSYC 3030	EXPER. ANALYSIS OF BEHAVIOR	3
PSYC 3035	E.A.B. LAB	1
PSYC 3XXX ELECTIVE		3
HUMANITIES ELECTIVE		3
FREE ELECTIVES		6
TOTAL SEMESTER HOURS		16

Fourth Year - Fall Semester

Course Number/Name		*Hours*
PSYC 3040	SENSATION AND PERCEP.	3
PSYC 3045	SENS. AND PERCEP. LAB	1
PSYC 4010	HUMAN ABILITIES	3
PSYC 4015	HUMAN ABILITIES LAB	1
PSYC 3XXX	ELECTIVE	3
FREE ELECTIVE		3
TOTAL SEMESTER HOURS		14

Fourth Year - Spring Semester

Course Number/Name		*Hours*
PSYC 4030	APPLIED EXPERIMENTAL PSYCH.	3
PSYC 4035	APPLIED EXPER. LAB	1
PSYC 4050	HISTORY AND SYSTEMS	3
PSYC 3XXX ELECTIVE		3
FREE ELECTIVE		3
TOTAL SEMESTER HOURS		13

TOTAL PROGRAM HOURS = 120 SEMESTER HOURS PLUS WELLNESS (2 HOURS)

Requirements and Electives

General Education

MATH 1501-2 PLUS one additional non-management mathematics course at the 2000 level or higher.
BIOL 1510-20.
CHEM 1211 and 1311 OR PHYS 2211 and 2212 OR one semester of each.
One course from HIST 2111, HIST 2112, INTA 1200, POL 1101, or PUBP 3000 to satisfy a state requirement regarding course work in the history and constitutions of the U.S. and Georgia.

Preliminary Courses for the Psychology Major

PSYC 1101 General Psychology
PSYC 2010 Research Methods
PSYC 2020 Psychological Statistics

Other Curriculum Requirements

Students must take the required courses as presented in the curriculum, including at least 2 laboratory courses in psychology. In addition to the required courses, the student must take 12 hours of 3000 level or above psychology elective courses. These may include 6 hours of Special Problems or Special Topics. Students who demonstrate special promise may be invited to conduct a senior thesis.

Premedical Preparation

Premedical students must take chemistry (CHEM 1211, 1311) AND physics (PHYS 2211, 2212). In addition, premedical students must take EITHER CHEM 1312 (Inorganic Laboratory) OR 1313 (Introduction to Quantitative Methods) AND CHEM 2311 (Organic I), 2312 (Organic II) AND 2381 (Synthesis Laboratory I).

Graduate Programs

Doctoral and master's candidates share a core curriculum in general psychology and quantitative methods. Doctoral candidates will complete all requirements for the master's degree, which includes writing a research thesis.

The master's degree prepares the student for continuation of graduate work toward the Ph.D. Most students require a minimum of two calendar years to complete the master's degree, which includes writing a thesis.

The doctoral program provides the student with an opportunity for advanced study in experimental (focus areas in cognitive science, cognitive aging, and animal behavior), industrial-organizational, or engineering psychology. Each of these curricula consists of additional courses and programs of individual study and research beyond the core curriculum, which contribute to a strong background in general experimental psychology and the student's area of specialization. The doctoral program will ordinarily require at least four years for students who enter immediately after obtaining the bachelor's degree.

Admission to graduate study in psychology with full graduate standing in the School of Psychology requires the equivalent of an undergraduate major in psychology or a related field with courses in general and experimental psychology, as well as psychological statistics. All applicants should submit scores on the Graduate Record Examination.

The psychology faculty will consider admissions applications from competent students who have majored in subjects other than psychology.

Graphics, Visualization, and Usability (GVU) Center's Suggested Courses for Graduate Minor

To fulfill their graduate minor requirements, psychology graduate students may take an interdisciplinary sequence of courses suggested by the Graphics, Visualization, and Usability Center. Three different tracks of study are designed to provide a systematic overview of a given area: one specializing in graphics, another in visualization, and a third in usability. Courses for these three tracks are specified in the College of Computing section of this catalog.

Graduate Certificate in Cognitive Sciences

Cognitive science is an interdisciplinary research area spanning psychology, computer science, linguistics, and philosophy. The certificate in cognitive science provides students with a structured set of courses from related disciplines. Psychology students usually sample artificial intelligence courses (from computer science) and human systems engineering courses (from industrial and systems engineering). Two interactive courses are specifically designed to give students a systematic exposure to cognitive science. The courses for the certificate can also function as the student's graduate minor. An extended description of the program can be found in the catalog section for the College of Computing.

Courses of Instruction

Figures entered below the course number and title of each course signify the number of class hours per week, the number of lab hours per week, and the semester hour credit earned for the completed course.

PSYCHOLOGY

PSYC 1000. Adjustment to College Life
1-0-1.
Discussion of topics related to academic and professional success including time management, learning skills, career planning, psychological hardiness, team work, and leadership.

PSYC 1101. General Psychology
3-0-3.
A survey of methods, findings, and theories of the science of mind and behavior.

PSYC 2010. Research Methods
2-3-3. Prerequisite(s): PSYC 1101
Introduction to methods used in conducting research on human behavior. Experimental research will be emphasized, but the course will cover other methods and some statistics.

PSYC 2020. Psychological Statistics
3-3-4. Prerequisite(s): MATH 1502 and PSYC 2010
Introduction to probability and statistics as applied to psychological data. Tests for means, variances, correlation, ANVOA, and regression.

PSYC 2103. Human Development Over the Life Span
3-0-3. Prerequisite(s): PSYC 1101
Theories and issues in human development including cognitive, social, and emotional development. The course is organized topically rather than chronologically.

PSYC 2210. Social Psychology
3-0-3. Prerequisite(s): PSYC 1101
Consideration of the behavior of individuals in social contexts, including interpersonal and group settings.

PSYC 2220. Industrial/Organizational Psychology
3-0-3.
An introduction to industrial/organizational psychology providing an overview of behavior in the workplace and psychology applied in industrial and organizational settings.

PSYC 2230. Abnormal Psychology
3-0-3. Prerequisite(s): PSYC 1101
This course surveys the spectrum of psychiatric disorders (symptoms, epidemiology, etiology, and treatment) and provides a perspective on adaptive functioning and psychological resilience.

PSYC 2240. Personality Theory
3-0-3. Prerequisite(s): PSYC 1101
Introduction to major approaches to personality theory.

PSYC 2260. Psychology of Aging
3-0-3. Prerequisite(s): PSYC 1101
Survey of research concerned with the nature and causes of adult age differences in behavior.

PSYC 2270. Introduction to Engineering Psychology
3-0-3. Prerequisite(s): PSYC 1101
Engineering psychology presented as an integral component in the design and evaluation of human-machine systems. Applied problems and general methodological questions are examined.

PSYC 2300. Psychology of Advertising
3-0-3. Prerequisite(s): PSYC 1101
An examination of contemporary advertisers' use of basic psychological principles in advertising. Concepts explored include memory, attention, comparative advertising, and attitude change.

PSYC 2400. Psychology and Contemporary Issues in Society
3-0-3. Prerequisite(s): PSY 1101
Contributions of psychology to an appreciation of selected contemporary issues.

PSYC 2801,-2,-3. Special Topics
Credit and class hours equal last digit of course number.
Special Topics of current interest.

PSYC 2901,-2,-3. Special Problems
Credit hours to be arranged.
Special problems of current interest.

PSYC 3010. Survey of Cognitive Psychology
3-0-3. Prerequisite(s): PSYC 1101; Co-requisite: PSY 3015.
Exploration of the central aspects of human cognition including pattern recognition, attention, memory, language, categorization, problem solving, and decision making. Phenomena and methods are stressed.

PSYC 3015. Cognitive Psychology Laboratory
0-3-1. Co-requisite: PSY 3010.
Lab section to accompany PSY 3010 should be taken concurrently. This cognitive psychology lab covers topics addressed in the lecture section of the course.

PSYC 3020. Biopsychology
3-0-3. Prerequisite(s): PSYC 1101 and BIOL 1510 and BIOL 1520
Neurophysiological, endocrinological, and biochemical bases of sensory and motor functioning, motivation, learning, memory, and behavior dysfunction.

PSYC 3030. Experimental Analysis of Behavior
3-0-3. Prerequisite(s): BIOL 1510 and PSYC 2020
History, theory, and methods of behavior analysis. Topics include shaping, stimulus-stimulus and response-consequence contingencies, stimulus control and choice.

PSYC 3035. Experimental Analysis of Behavior Laboratory
0-3-1. Prerequisite(s): BIOL 1510 and PSYC 2020;
Co-requisite: PSYC 3030.
Applications of the principles of operant conditioning including shaping and stimulus control. Conducted largly at Zoo Atlanta.

PSYC 3040. Sensation and Perception
3-0-3. Prerequisite(s): BIOL 1510 and PSYC 2020
An examination of how sensations and perceptions are processed by humans. Topics covered will include vision, hearing, the skin senses, taste, smell, and the vestibular senses.

PSYC 3045. Sensation and Perception Laboratory
0-3-1. Prerequisite(s): BIOL 1510 and PSYC 2020;
Co-requisite: PSYC 3040.
A study of how sensations and perceptions of the outside world are processed by humans, by actually doing experiments and other "hands-on" activities.

PSYC 3050. Introduction to Psychological Testing
3-0-3. Prerequisite(s): PSYC 2020
Considers fundamentals of test construction (normative v. ipsative scoring, reliability, validity, item analysis) and specific applications in clinical, academic, occupational, and forensic arena.

PSYC 3060. Comparative Psychology
2-2-3. Prerequisite(s): PSYC 1101 and BIOL 1510 and BIOL 1520
Consideration of principles and research methods of animal psychology and ethology. Literature reviews and reports, field trips, and laboratory studies.

PSYC 3790. Introduction to Cognitive Science
3-0-3.
Multidisciplinary perspectives on cognitive science. Interdisciplinary approaches to issues in cognition, including memory, language, problem solving, learning, perception, and action. Crosslisted with CS, PST, and ISYE 3790.

PSYC 4010. Human Abilities
3-0-3. Prerequisite(s): PSYC 2020
Theory, methods, and applications of research on human abilities, including intelligence, aptitude, achievement. learning, aptitude treatment interactions, information processing correlates, and measurement issues.

PSYC 4015. Human Abilities Laboratory
0-3-1. Co-requisite: PSYC 4010.
Provides indepth illustration of methods and applications of research on human abilities, including intelligence, aptitude, achievement, learning, aptitude-treatment interactions, and information processing/ability relationships.

PSYC 4030. Applied Experimental Psychology
3-0-3. Prerequisite(s): PSYC 2020 and PSYC 3010
Consideration of the applications of methods and data of experimental psychology. Understanding of human capabilities and limitations is applied to design of technology and environments.

PSYC 4035. Applied Experimental Psychology Laboratory
0-3-1. Co-requisite: PSYC 4030.
Applications-oriented research methods of experimental psychology to applied research and product design situations.

PSYC 4050. History and Systems
3-0-3.
A survey of the history of psychology from the Hellenic age to the modern systems.

PSYC 4060. Principles of Memory and Attention
3-0-3. Prerequisite(s): PSYC 3010
Indepth study of memory and attention with an emphasis on major theories and principles. Skill aquisition, expertise, aging, and neural bases are also addressed.

PSYC 4070. Psychology of Language
3-0-3. Prerequisite(s): PSYC 3010
Language phenomena and theories. Topics: structure and function comprehension and production; acquisition; reading and writing; bilingualism; gesture; neuropsychological bases; relations between language and thought.

PSYC 4080. Thinking
3-0-3. Prerequisite(s): PSYC 3010
Phenomena, theories, and applications in the psychology of thought. Deductive reasoning, reasoning under uncertainty, decision making, problem solving, expertise and complex learning.

PSYC 4100. Behavioral Pharmacology
3-0-3. Prerequisite(s): PSYC 1101 and BIOL 1510 and BIOL 1520 and CHEM 1211
An analysis of drug-behavior interactions with emphasis on basic pharmacology, role of contingencies in drug effects, mechanisms of drug dependency, drugs as stimuli, and basic neuropharmacology.

PSYC 4310,-20. Field Studies in Animal Behavior I,-II
1-6-3, each.
Course takes place in the field (Africa, South America, or Asia) and is limited to 15 qualified students. Lectures by instructor provide in-class portion. Visits to national parks, game reserves, and in-field observations will introduce students to natural habitats.

PSYC 4500. Senior Thesis/Practicum
2-3-3.
For selected students to conduct original work under the direction of a faculty member.

PSYC 4750. Human-Computer Interface Design and Evaluation
3-0-3. Prerequisite(s): PSYC 1101 and CS 1301
Human-computer interface is considered in terms of user-system compatibility. Concepts in human factors and interface design are covered in relation to capabilities of both humans and computers. Crosslisted with CS 4750.

PSYC 4761. Models of Human Information Processing
3-0-3. Prerequisite(s): PSYC 1101
General and unified approaches to psychological and computer modeling of human information processing. Crosslisted with CS 4761.

PSYC 4770. Psychology and Environmental Design
2-3-3.
Introduction of psychological concepts relevant to environmental design. Survey of selected methods for assessing human-made environments and development of design solutions to selected problems. Crosslisted with ARCH 4770.

PSYC 4790. Seminar in Cognitive Science
3-0-3.
A seminar-type course in cognitive science focusing on integrating and deepening students' cognitive science knowledge and skills. Topics include memory, language, problem solving, learning, perception, and action. Crosslisted with CS, PST, and ISYE 4790.

PSYC 4791. Integrative Project in Cognitive Science
3-0-3.
An integrative course in cognitive science focusing on the integration and use of concepts and skills from cognitive science. A different integrative project or set of projects will be taken on each semester; students will contribute on the basis of their background and skills. Crosslisted with CS, ISYE, and PST 4791.

PSYC 4792. Design Project in Cognitive Science
3-0-3.
Individual project with a cognitive science faculty member, designed as a supplement to the student's senior design project or thesis in their major area. Crosslisted with CS, ISYE, and PST 4792.

PSYC 4801,-2,-3,-4. Special Topics
3-0-3, each.
Special topics or courses of an experimental nature.

PSYC 4900. Special Problems
Credit hours to be arranged. Prerequisite(s): PSYC 2020
Students engage in individual and group projects under the direction of a faculty member.

PSYC 4901,-2,-3,-4,-5,-6,-7,-8,-9,-10. Special Problems
Credit hours to be arranged. Prerequisite(s): PSYC 2010 and PSYC 2020
Students engage in individual and group projects under the direction of a faculty member.

PSYC 6011. Cognitive Psychology
3-0-3.
Survey course on human cognition including pattern recognition, attention, memory, categorization, problem solving, consciousness, decision making, intention, and the relation between mind and brain.

PSYC 6012. Social Psychology
3-0-3.
Fundamental theory and research in social behavior including social perception/cognition, attitude formation and change, social influences, and group processes.

PSYC 6013. Biopsychology
3-0-3.
Neurophysiological, endocrinological, and biochemical bases of sensory and motor functioning, motivation, learning, memory, and behavior dysfunction.

PSYC 6014. Sensation and Perception
3-0-3.
This course examines how sensations and perceptions of the outside world are processed by humans, including physiological, psychophysical, ecological, and computational perspectives.

PSYC 6015. Developmental Psychology
3-0-3.
Overview of concepts, assumptions, methods, theories, and research in human development across the life span including cognitive, emotional, and social behavior.

PSYC 6016. Experimental Analysis of Behavior
3-0-3.
Conceptual, methodological, and theoretical issues in the experimental analysis of behavior with special emphasis on classical and operant conditioning as foundations for complex behavior.

PSYC 6017. Individual Differences
3-0-3.
Introduction to differential psychology providing an overview of differences in humans. Topics such as abilities, temperament, and group differences (e.g. gender) are addressed.

PSYC 6018. Principles of Research Design
3-0-3. Co-requisite: PSYC 6019.
Introduction to basic principles and practices of empirical research in psychology. Covers both experimental and correlational methods and designs.

PSYC 6019. Statistical Analysis of Psychological Data I
4-3-5. Co-requisite: PSYC 6018.
Introductory treatment of descriptive and inferential statistics as applied to psychological research.

PSYC 6020. Statistical Analysis of Psychological Data II
4-3-5. Prerequisite(s): PSYC 6019
Introductory treatment of inferential statistics, especially the general linear model, as applied to psychological research.

PSYC 6750. Human-Computer Interface
3-0-3.
Describes the characteristics of interaction between humans and computers and demonstrates techniques for the evaluation of user-centered systems. Crosslisted with CS 6750.

PSYC 6795. Introduction to Cognitive Science
3-0-3.
Multidisciplinary perspectives on cognitive science. Interdisciplinary approaches to issues in cognition, including memory, language, problem solving, learning, perception, and action. Crosslisted with CS and ISYE 6795.

PSYC 7000. Master's Thesis
Credit hours to be arranged.

PSYC 7020. Survey of Cognitive Aging
3-0-3.
Introduction to theory and research on adult cognitive development, including intelligence, attention, memory, and problem solving.

PSYC 7101. Engineering Psychology I: Methods
3-0-3.
Basic methods used to study human-machine systems including both system analysis and human performance evaluation techniques. These methods will be applied to specific systems.

PSYC 7102. Engineering Psychology II: Displays, Controls, and Workspace Design
3-0-3.
Basic principles of human factors for the design, evaluation, and use of displays, controls, and workspace layouts including new technologies and associated human factors problems.

PSYC 7103. Engineering Psychology III: Environmental Stressors and Human Performance
3-0-3.
Environmental stressors and their influences on human performance, physiological function, and emotional responses including work/rest cycles, jetlag, noise, vibration, glare, weightlessness, etc.

PSYC 7104. Psychomotor and Cognitive Skill Learning and Performance
3-0-3.
Human capabilities and limitations for learning and performing psychomotor and cognitive skills are studied.

PSYC 7201. Industrial/Organizational Psychology
3-0-3.
This course introduces an overview of issues relevant to behavior in the workplace and psychology applied in industrial and organizational settings.

PSYC 7202. Employee Selection
3-0-3.
The course provides a conceptual framework for personnel selection guided by scientific principles, research, and theory as well as by professional, legal, and technical guidelines.

PSYC 7203. Motivation and Job Attitudes
3-0-3.
Examines theory and pragmatics in description, prediction, and measurement of work-related behavior and associated evaluations. Includes theoretical and methodological problems in field and laboratory contexts.

PSYC 7204. Training and Development
3-0-3.
This course will focus on theory, principles, techniques, and practices relevant to training and developing human resources. Research and professional literature will be examined.

PSYC 7301. Introduction to Multivariate Statistics
3-0-3.
Foundations for multivariate analysis including properties of linear composite variables, multiple regression, multiple and partial correlation, MANOVA, factor analysis, multiple discriminant analysis, canonical correlation, etc.

PSYC 7302. Structural Equation Modeling
3-0-3.
Methods of causal modeling to study causal relations including issues of causality, establishing causality, fundamentals of linear structural equation modeling with latent variables, fitting models.

PSYC 7303. Psychometric Theory
3-0-3.
Preparation of students in statistical theory and techniques relevant to becoming professionally involved in construction, analysis, and evaluation of psychology and personnel tests.

PSYC 7700. Professional Problems
2-0-2.
Discussion of issues faced by professional psychologists in the areas of teaching, research, and professional practice. Ethical issues in all of these areas are emphasized.

PSYC 7701. Teaching Practicum
1-3-2.
Supervised college teaching including techniques, course and curriculum design, evaluation. Students will prepare and present lectures with direct observations and videotaping for discussion.

PSYC 7790. Cognitive Modeling
2-6-4. Prerequisite(s): CS 6795 or ISYE 6795 or PSYC 6795
A hands-on course covering a range of cognitive modeling methodologies. It explores the analysis, development, construction, and evaluation of models of cognitive processing. Crosslisted with CS and ISYE 7790.

PSYC 7999. Preparation for Doctoral Qualifying Exam
Credit hours to be arranged.

PSYC 8000. Seminar in Experimental Psychology
3-0-3.
Critical examination of current problems in a selected area of general experimental psychology. Areas to be discussed may vary each time course is offered.

PSYC 8010. Seminar in Cognitive Psychology
3-0-3.
Critical examination of current problems in a selected area of cognitive psychology. Areas to be discussed may vary each time course is offered.

PSYC 8020. Seminar in Cognitive Aging
3-0-3.
Critical examination of current problems in a selected area of cognitive aging. Areas to be discussed may vary each time course is offered.

PSYC 8030. Seminar in Comparative Psychology
3-0-3.
Critical examination of current problems in a selected area of comparative psychology. Areas to be discussed may vary each time course is offered.

PSYC 8040. Seminar in Engineering Psychology
3-0-3.
Critical examination of current problems in a selected area of engineering psychology. Areas to be discussed may vary each time course is offered.

PSYC 8050. Seminar in Industrial/Organizational Psychology
3-0-3.
Critical examination of current problems in a selected area of industrial/organizational psychology. Areas to be discussed may vary each time course is offered.

PSYC 8060. Seminar in Quantitative Psychology
3-0-3.
Presentation and discussion of quantitative approaches to psychology. Topics will vary, but might include neural networks, measurement theory, behavioral ecology, modeling, system dynamics, etc.

PSYC 8795. Colloquium in Cognitive Science
1-0-1.
Reading of research papers by leading cognitive scientists, attendance at their colloquia, and meeting with them to discuss research. Crosslisted with CS and ISYE 8795.

PSYC 8800. Special Topics in Applied Statistics
3-0-3.
Covers current issues and recent advances in the application of statistical methods to research in psychology. Instructors select the specific focus for a given seminar.

PSYC 8890. Special Topics in Cognitive Science
3-0-3.

PSYC 8900. Special Problems in Experimental Psychology
Credit hours to be arranged.
Students conduct research under direction of a faculty member on problems in the general area of experimental psychology.

PSYC 8901. Special Problems in Engineering Psychology
Credit hours to be arranged.
Students conduct research under the direction of a faculty member on problems in the general area of engineering psychology.

PSYC 8902. Special Problems in Industrial/ Organizational Psychology
Credit hours to be arranged.
Students conduct research under the direction of a faculty member on problems investigating some psychological aspect of industrial/organizational problems.

PSYC 8997. Teaching Assistantship
Credit hours to be arranged.
For graduate students holding a teaching assistantship.

PSYC 8998. Research Assistantship
Credit hours to be arranged.
For graduate students holding a research assistantship.

PSYC 9000. Doctoral Thesis
Credit hours to be arranged.


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Rules and Regulations

Student Rules and Regulations

Originally approved by the faculty May 24, 1949. The most recent major revision was approved by the faculty on December 1, 1998.

Index

I. Purpose

These regulations are intended to set forth the requirements of the faculty to the end that a large student body may live and work together harmoniously with a minimum of friction and misunderstanding. Each student is expected to be a law-abiding citizen and to obey the laws of the city of Atlanta, Fulton County, the state of Georgia, and the United States.

II. Academic Calendar

A. Standard Calendar

The standard academic calendar of the Georgia Institute of Technology consists of fall and spring semesters and an accelerated summer session. Each semester normally includes approximately 15 weeks of instruction plus one week of final examinations; the normal summer session includes approximately 11 weeks of instruction plus one week of final examinations. An "academic year" consists of the fall and spring semesters; a "catalog year" consists of an academic year plus the preceding summer session. "Term" may refer to either a semester or a summer session. The Office of the Registrar publishes the official calendar for each academic term.

B. Other Academic Terms

In addition to the standard academic calendar, certain programs may be offered on other schedules. All such offerings are subject to the approval of the Institute Undergraduate Curriculum Committee, Institute Graduate Committee, and/or the registrar, as appropriate. With approval, such programs may operate under different academic rules, such as credit-hour limits or withdrawal dates, than those specified for standard academic terms.

III. Responsibility for Notices and Change of Address

A. Notices

All students will be required to have a box in the post office of the Georgia Institute of Technology, which will be their official school address, and they are expected to check this box each school day. Students are also expected to be aware of the contents of individual notices placed in the post office box and that appear on the Student Access System or electronic mail, as well as general notices that appear in *The Technique*. It is the student's responsibility to check the Student Access System during the drop/add period of registration and during the term to verify the accuracy of his/her schedule and for notices. Schedules should be verified at least once during the first five weeks of the term and once after mid-term.

B. Change of Address

Students are responsible for reporting all changes within one week to the Office of the Registrar or on the Student Access System.

C. Unclaimed Mail

Students are responsible for returning to the front window of the post office all mail in their post office boxes that is unclaimed after three days.

IV. Attendance

A. General

1. Each term, a course listing is published showing the time period for each class.
2. If an instructor should be late in meeting the class, the students shall wait 20 minutes after the published starting time. If the instructor has not arrived by that time, the students may leave unless specifically notified to await the instructor's arrival.

B. Class Attendance

1. There are no formal institutional regulations regarding class attendance at the Georgia Institute of Technology. The resources of the Institute are provided for the intellectual growth and development of the students who attend. A schedule of courses is provided for the students and faculty to facilitate an orderly arrangement of the program of instruction. The fact that classes are scheduled is evidence that attendance is important; students should, therefore, maintain regular attendance if they are to attain maximum success in the pursuit of their studies.
2. All students are responsible for obtaining an understanding of each instructor's policy regarding absences; all students are expected to attend announced quizzes, laboratory periods, and final examinations. Although it is recognized that occasionally it may be necessary for students to be absent from scheduled classes or laboratories for personal reasons, students are responsible for all material covered in their absences, and they are responsible for the academic consequences of their absences. Work missed may be made up if the reasons for absences are acceptable to the instructors.

3. Students who are absent because of participation in approved Institute activities (such as field trips and athletic events) will be permitted to make up the work missed during their absences. Approval of such activities will be granted by the Student Academic and Financial Affairs Committee of the Academic Senate, and statements of the approved absence may be obtained from the Office of the Registrar.

V. Grades and Scholastic Average

A. Grades

1. The letter grades for completed courses used in the calculation of scholastic average are the following:
A — excellent (four quality points)
B — good (three quality points)
C — satisfactory (two quality points)
D — passing (one quality point)
F — failure, must be repeated if in a required course (no quality points)
2. The following grades will be used in the cases indicated and will not be included in the calculation of scholastic average:
S — passing of a course taken under pass/fail or completion of a course in which no letter grade may be assigned;
U — unsatisfactory in a course taken under pass/fail or unsatisfactory performance in a course for which no letter grade may be assigned;
V — assigned when the course has been audited; no credit given; and implies no academic achievement on the part of the student.
3. The following grades will be used in the cases indicated and will not be included in the calculation of scholastic average:
I — incomplete. Assigned when a student was doing satisfactory work, but for nonacademic reasons beyond his/her control and deemed acceptable by the instructor, was unable to meet the full requirements of the course. If the student's performance was so poor as to preclude his/her passing, the instructor shall assign the grade of *F*. Refer to section VII.B for regulations regarding removal of the *I* grade.
W — withdrawal without penalty. Withdrawals without penalty will not be permitted after the eighth week of the semester or fifth week of the summer term, except in cases of hardship as determined by the Institute Undergraduate Curriculum Committee or Graduate Committee, as appropriate. Ordinarily, students who withdraw from school and receive all grades of *W* will not be permitted to re-enroll the next succeeding term. Refer to section VIII.B for regulations regarding readmission.
NR — not reported. Assigned when an instructor fails to submit grades by the published deadline, through no fault of the student.
4. Final grades are reported to the registrar at the end of each term.
5. If a final course grade is believed to be in error, the student should contact the professor as soon as possible. In general, no change of grade will be made after the end of the student's next term in residence.

B. Scholastic Average

The scholastic average is calculated as the ratio of the total number of quality points earned to the total number of credit hours in which a final letter grade has been assigned.

VI. Scholastic Regulations

A. Classification of Students

1. Undergraduate students, with the exception of nondegree-seeking students, shall be classified at the end of each term by the Office of the Registrar on the basis of the total number of semester credit hours for which they have credit in accordance with the following schedule:

Freshman	0-29	credit hours
Sophomore	30-59	credit hours
Junior	60-89	credit hours
Senior	90 +	credit hours

Students who have completed all requirements for a particular classification as defined by their major department may petition for reclassification through their major department.
2. Students scheduled for at least 12 credit hours in a semester, or at least 9 credit hours in the summer term, are classified as full-time students.

B. Eligibility for Class Rings

A student may purchase a class ring any time after receiving credit for 70 semester credit hours.

C. Scholastic Standing

1. The minimum satisfactory scholastic average is 1.70 for freshmen, 1.90 for sophomores, 2.00 for juniors and seniors, 2.70 for master's students, and 3.00 for doctoral students.
2. Good academic standing
Students not on academic probation are in good academic standing.

3. Academic warning
a) Academic warning is a subcategory of good academic standing, differing only in the maximum allowable schedule load.
b) A student who has an overall scholastic average below the minimum satisfactory scholarship requirement, or whose scholastic average for work taken during any term is below this requirement, shall be placed on academic warning.
4. Academic probation
a) A student on academic warning whose scholastic average is below the minimum satisfactory scholarship requirement for any term shall be placed on academic probation.
b) A student also may be placed on academic probation through other actions, as described in the following section.
5. Dismissal for unsatisfactory scholarship
a) The Institute may drop from the rolls at any time a student whose record in scholarship is unsatisfactory.
b) An undergraduate student whose scholastic average for any term is 1.00 or below may be referred to the Undergraduate Curriculum Committee, which may place the student on academic probation or drop, regardless of the student's previous record, if such action is deemed advisable.
c) A graduate student whose scholastic average for any term is 2.00 or below may be placed on academic probation or dropped, regardless of the student's previous record.
d) A student on academic probation whose scholastic average for the term of probation is below the minimum satisfactory scholarship requirement and whose overall scholastic average is below the minimum satisfactory scholarship requirement shall be dropped from the rolls for unsatisfactory scholarship.
e) The record of a student on academic probation whose term average is unsatisfactory, but whose overall scholastic record is satisfactory, may be reviewed by the Undergraduate Curriculum Committee or the Graduate Committee, as appropriate. The student may be dropped or may be continued on academic probation.
6. Academic review
A student who normally would be dropped from the rolls for academic deficiencies but appears from the record not to have completed the term may be placed on academic review. This is a temporary standing that makes the student ineligible for registration. If no acceptable explanation is given within a reasonable time, the standing is changed to drop.
7. The scholastic standing regulations given previously for graduate students do not preclude a school from having more rigorous requirements.
8. These regulations do not necessarily apply to students who are enrolled for less than a full-time load. The scholastic standing of these students may be determined by either the Undergraduate Curriculum Committee or the Graduate Committee, as appropriate, with the decision based on individual merit in each case.

D. Maximum Schedule Load

1. The maximum number of credit hours for which an undergraduate student may register in fall or spring semester, based on his or her academic standing, is as follows:

Good	21 semester hours
Warning	16 semester hours
Probation	14 semester hours

2. The maximum number of credit hours for which an undergraduate student may register in a normal summer term, based on his or her academic standing, is as follows:

Good	16 semester hours
Warning	14 semester hours
Probation	12 semester hours

3. A graduate student may register for a maximum of 21 semester hours in fall or spring semester and a maximum of 16 semester hours during the normal summer term.
4. Requests for schedule overloads must be recommended by the student's major school and approved by the Institute Undergraduate Curriculum Committee or Graduate Committee, as appropriate.

E. Academic Honors

The Institute encourages excellence in scholarship and gives official recognition to undergraduate students whose work is superior in any given term.
1. Dean's List - includes all undergraduates who, during the preceding term, made an academic average of 3.00 or higher, completed a schedule of at least 12 hours (9 hours in the summer term) of course work on a letter-grade basis, and are not on academic warning or probation or subject to any disciplinary action. (All grades must be reported.)

2. Faculty honors - includes all undergraduates who during the preceding term made an academic average of 4.00, completed a schedule of at least 12 hours (9 hours in the summer term) of course work on a letter-grade basis, with no *W* grades, and are not on academic warning or probation or subject to any disciplinary action. (All grades must be reported.)

F. Change of Major

1. Undergraduate students, by filing the required form, will be permitted one unrestricted transfer between majors (including undecided) until they have accumulated credit for 60 hours. After 60 hours or upon subsequent request for transfer, the transfer will be permitted at the discretion of the school that the student is seeking to enter. (Note: Certain majors, because of high enrollment, have been granted a waiver of the one unrestricted transfer regulation. Students should consult with the individual school concerning its current transfer policy.)
2. Graduate students, by filing the required form, may transfer with the concurrence of the schools involved and the graduate dean.

G. Exceptions

Exceptions to these scholastic regulations may be made by the Undergraduate Curriculum Committee or the Graduate Committee, as appropriate, whenever a consideration of the student's complete record indicates that the application of a specific regulation will result in injustice.

VII. Deficiencies

A. General

1. A student who has received a grade of *I*, *F*, or *U* in a course has a deficiency in the course.
2. A student whose final grade is *F* or *U* has a failure in that course. The student must repeat and pass the course in class before credit will be allowed. (See section B.4 below.)

B. Removal of Deficiencies

1. If a grade of *I* (incomplete) is assigned in a course, the incomplete must be removed and the grade change reported by the end of the student's next term in residence or, if the student has not been enrolled, by the end of the term one calendar year from the date the incomplete was assigned. To remove the incomplete, the student should consult with the instructor as soon as possible after the term is over and complete whatever remaining work is outlined by the instructor. Repeating the course for credit does not remove the grade of *I*.
2. If a student who received a grade of *I* never re-enrolls, the grade remains on the record. However, if the student is readmitted or attends the Institute at another level after a period of at least one year, the grade of *I* will be changed to the grade of *F* upon readmission or matriculation at another level.
3. A student who has a failure in a required course must schedule that course the next time it is offered while the student is in residence.
4. A degree candidate who has a single course deficiency for graduation will be permitted one re-examination not later than 72 hours before commencement exercises and thereafter one examination per annum until the deficiency is removed, with the dates of the annual periods beginning 30 calendar days after the commencement exercises. This re-examination must be authorized by the registrar before being scheduled. The examination will be graded *S* or *U* and the grade so recorded. The previously assigned *F* or *U* will remain a part of the record.
5. A degree candidate who has otherwise completed all requirements for graduation and who has an incomplete in laboratory work taken during his or her final term in residence may remove the incomplete at the convenience of the department of instruction concerned.

VIII. Withdrawal from School and Readmission

A. Withdrawal

1. A student 18 years of age or older may withdraw from school upon the submission of a formal resignation during the first eight weeks of a semester or the first five weeks of the summer term.
2. A student under 18 years of age must include written permission from parents or guardian along with a formal resignation in order to withdraw from school before the official close of a term.
3. The proper forms for withdrawal are available from the Office of the Registrar. Students who withdraw without proper notification will receive grades of *F*, *U*, or *I* for the courses in which they were registered that term.

4. Permission and/or formal resignation are not required when a student has completed an official school term and does not register for the succeeding term.
5. See section V.A.3 for further information on withdrawal.

B. Readmission

1. Any student who is not enrolled for two or more consecutive terms must apply for readmission. This application, with all the pertinent supporting information (except possibly another college transcript-see 2 below), must be submitted to the registrar before the deadline for the term for which readmission is requested, as listed below:

    Fall - July 1
    Spring - December 1
    Summer - April 1

Applications received after these deadlines will not be accepted.
2. Students who have attended other colleges should plan their readmission so as to allow ample time for official transcripts from those colleges to be sent to the Georgia Institute of Technology. If official transcripts have not been received prior to the last day of registration, the student seeking readmission will not be allowed to complete registration.
3. Any student in good standing who is not enrolled for a single term will be allowed to re-enroll without applying for readmission to the Institute. There will be no distinction between the terms of the regular academic year and the summer term.
4. A student who is on Academic Warning or Academic Probation who is not enrolled for a single term will have an automatic hold placed on registration that must be cleared by the student's major school. For example, a student is placed on academic probation at the close of fall term and fails to enroll by the close of registration for the spring term. An automatic registration hold will be set, which must be cleared by the major school before the student can register for any future term.
5. A student who has been dropped once for unsatisfactory scholarship will ordinarily not be readmitted. A student who seeks an exception to this rule must have been out of the Institute for at least one term of the academic year and have had a conference with the major school concerning the readmission prior to the appropriate date listed previously. Because the summer term is not included in the academic year, students who are dropped at the end of the spring term will not be eligible for readmission until the beginning of the following spring term.
6. A student who is dropped a second time for unsatisfactory scholarship will not be readmitted to the Institute.
7. Any student, except a part-time graduate student, who withdraws during a term and wishes to return the following term must complete a readmission application and a Petition to the Faculty for consideration. Part-time graduate students are required to complete only a readmission application. These documents must be submitted to the registrar before the deadline for the term for which readmission is requested.

C. Transfer Credit

1. Course work pursued at another institution after dismissal from Georgia Tech for unsatisfactory scholarship may be considered as evidence for readmission.
2. If readmitted, a student will not necessarily be given transfer credit for work taken at another institution after dismissal from Georgia Tech.
3. In no case will credit be allowed (except by examination) for courses completed at another institution that have previously been failed at Georgia Tech.

D. Study Abroad

Any student in Good Standing choosing to participate in an approved Study Abroad program for two or more terms must complete a student Information Update form with the Study Abroad coordinator prior to departure. This form will enable the student to re-enroll for the term of "planned re-entry" without submitting a formal readmission application. It will be the student's responsibility to inform the Study Abroad coordinator of any change in the planned re-entry date.

IX. Scheduling

A. General

1. All previously scheduled course work takes precedence over newly scheduled material. Therefore, all work that is incomplete from a previous term should be completed, or arrangements to complete it should be made prior to placing emphasis on new course work.

2. Students must follow the approved curriculum of the academic school in which they are registered. Students who do not follow the approved curriculum may be denied registration privileges.
3. Each student is strongly advised each term to schedule all prerequisite courses possible and should schedule all back courses before scheduling any advanced courses.
4. The completion of incomplete work from a previous term and the scheduling of out-of-sequence courses are the responsibility of the student, and they will be consequently held accountable.
5. Students may not repeat courses on a letter-grade basis in which the grade of *B* or higher has been earned previously.
6. Subject to approval by a faculty advisor, a course may be taken more than once for academic credit. All grades will count in determining the scholastic average, but the course will be counted only once for credit toward a degree.
7. See section X for Institute rules for courses taken on a pass/fail basis.

B. Academic Load

1. Maximum credit hour loads are given in section VI.D. Any hours above these limits must have prior approval of the Undergraduate Curriculum Committee or the Graduate Committee, as appropriate.
2. Graduate students must maintain a minimum of three credit hours each term of enrollment.

C. Auditing of Courses

1. Auditing of courses will be permitted to regularly enrolled students who have obtained the approval of their advisor and the departments concerned. Such courses count at full value in computing the student's load.
2. The grade for auditing is *V* (visitor), and this grade will have no effect on the student's grade point average.
3. No academic credit is granted for audit participation in a course.
4. Students are not permitted to change to or from an auditing status except through the regular procedures for schedule change or withdrawal.

X. Pass/Fail System

A. General

1. At the option of the student's major school, credit toward a bachelor's degree may be allowed for courses taken under the pass/fail system and completed with a grade of pass.
2. The major school must approve all pass/fail courses included in the final program of study, and students should become aware of school requirements.
3. In graduate programs, thesis research hours will be evaluated on a pass/fail basis.
4. Pass/fail enrollment in any course may be restricted by the school or department offering the course.
5. Students who are permitted to register under the pass/fail system will be so designated on the official class rolls; the grades recorded will be *S* for satisfactory or *U* for unsatisfactory. These grades will not be included in the calculation of the grade point average and cannot be changed to a grade that will count in the average.
6. Withdrawals from courses taken on a pass/fail basis will follow the same rules that govern withdrawals from courses included in the scholastic average.

B. Credit Hours Permitted

1. The maximum number of pass/fail hours permitted in an undergraduate program of study depends upon the number of semester credit hours that will be completed at Georgia Tech, as follows:

Hours included in program of study	Hours allowed on pass/fail basis
45 to 70 credit hours	3 credit hours
71 to 90 credit hours	6 credit hours
91 or more credit hours	9 credit hours

2. For a second undergraduate degree, these limitations apply to the credit hours included in the program of study for that second degree.
3. A master's degree program of study may include up to three semester credit hours on a pass/fail basis.

XI. Cross Enrollment - University Center in Georgia

A. General

1. With the approval of the student's major school, a student may schedule courses at any one of the colleges or universities comprising the University

Center in Georgia if such courses are not available in a particular term at Georgia Tech. A list of participating institutions is available from the Office of the Registrar.
2. All registration activities are performed at Georgia Tech.
3. Copies of the *Guidelines for Cross Registration among University Center Member Institutions* are available in the Office of the Registrar.

B. Eligibility

1. Cross enrollment is available only to degree-seeking juniors, seniors, and graduate students.
2. To participate in cross enrollment, a student must be in good standing during the term when the application is processed.
3. During the term of cross enrollment, the student must be carrying three or more credit hours at Georgia Tech and be in good standing. The total academic load carried may not exceed 21 hours.
4. Credits earned under cross enrollment will be handled as transfer credit, but will count as resident credit toward a degree. Grades received in cross enrollment courses will not be included in the calculation of the grade point average.

XII. Examinations

A. General

1. All re-examinations, examinations for advanced standing, and special examinations must be authorized by the registrar before being scheduled.
2. If the instructor considers it necessary during an examination, students may be required to present their student identification card to the instructor or an authorized representative.

B. Examinations for Advanced Standing

1. Students who offer satisfactory evidence that they are qualified to do so may receive credit for a course by examination. Such an examination is called an examination for advanced standing.
2. Examinations for advanced standing require the recommendation of the department of instruction in which the course is offered, payment of the appropriate fee, and authorization by the registrar.
3. Examinations for advanced standing will ordinarily be offered during the week of final examinations.
4. A student will not be allowed to take an examination for advanced standing in a given course more than twice.
5. An examination for advanced standing will be reported with an *S* or *U* grade. Neither grade will be included in the calculation of the scholastic average.

C. Final Examinations for Degree Candidates

A degree candidate will be exempted from examinations during final examination week in the term of graduation.

D. Regulations Covering Final Examinations

1. The Office of the Registrar will publish the final examination schedule and policies each term.
2. A student reporting to a final examination room more than 15 minutes after the scheduled starting time shall not be allowed to take the examination unless a satisfactory explanation is presented to the instructor conducting the examination.

XIII. Undergraduate Degrees

A. General

1. To be considered for admission to candidacy for a degree, a student must have passed the Regents' Test and must make a formal petition for the degree during the term preceding the final term in residence. A petition for degree will not be accepted until the Regents' Test has been passed.
2. Students desiring to withdraw their name from the rolls of degree candidates must formally withdraw the petition for degree before the end of the ninth week of the semester (or sixth week of the summer term).
3. A degree program may include a maximum of four hours of basic ROTC and a maximum of six hours of advanced ROTC.
4. The diploma of a candidate for a degree shall bear the date of the commencement at which the degree is awarded.
5. All requirements for the degree must be completed and certified by the registrar at least 72 hours prior to commencement. If a candidate for a degree is not certified at least 72 hours prior to commencement, the candidate will be graduated at the next scheduled commencement. The diploma will bear the date of the commencement at which the degree is awarded.

B. Residency Rule

No student may be considered a candidate for a degree unless the final 36 credit hours required for the degree are earned in residence at Georgia Tech and approved by the major school.

C. Ten-Year Rule

Work that was completed more than ten years prior to commencement must be validated by special examinations before it can be counted toward a degree.

D. Requirements for a Degree

1. To be a candidate for a degree, undergraduate students must have passed all courses required for the degree, must have a scholastic average for their entire academic program of at least 1.95, and must have done creditable work in their departmental courses so as to merit the recommendation for the degree by the chair and faculty of their school.

2. Students, with the approval of their school or specialization, may satisfy the requirements for an undergraduate degree by meeting all of the requirements listed in any one of the catalogs in effect during the period of their enrollment in the Institute or during their last two years (prior to their enrollment at Georgia Tech) in the program at one of the RETP schools. A catalog is in effect for a student only if the student's date of matriculation is prior to the ending date of the spring term shown in the calendar printed in the catalog concerned.

3. Constitution and history examinations

a) The Georgia law as amended March 4, 1953, requires that before graduation all students pass examinations or pass comparable courses in United States and Georgia history as well as the United States and Georgia constitutions.

b) Courses that may be substituted for the United States and Georgia constitutions and history examinations are listed in this catalog.

4. Regents' testing program

All students completing requirements for baccalaureate degrees are required by the University System of Georgia to pass an examination designed to measure proficiency in reading and English composition. This examination is known as the Regents' Test. It must be passed before a petition for graduation will be accepted. Students should obtain further information from the registrar.

5. Wellness requirement

a) Unless medically exempted, all students are required to complete HPS 1040 or 1061 before graduation.

b) The Health Information Record on file with the director of Health Services will be used to determine any medical exemptions from the wellness courses. All certificates of disability from personal physicians must be endorsed by Student Health Services before they will be accepted by the Department of Health and Performance Sciences.

E. Graduation with Academic Distinction

1. For graduation with highest honor, the minimum scholastic average shall be 3.55. For graduation with high honor, the minimum scholastic average shall be 3.35. For graduation with honor, the minimum scholastic average shall be 3.15.

2. A student must have earned at least 70 semester credit hours (excluding remedial course work) at Georgia Tech to graduate with highest honor, with high honor, or with honor.

3. In order to qualify for graduation with honors, all grades or grade corrections affecting the honors designation must be received and certified by the registrar at least 72 hours prior to commencement. Grades or grade corrections received after that time will have no bearing on the honors designation.

F. Second Undergraduate Degree

1. A student enrolled for a second undergraduate degree shall be classified as an undergraduate student, except that a graduate student wishing to pursue a second undergraduate degree will remain classified as a graduate student. A graduate student, with approval of the major school, may work toward a second undergraduate degree while pursuing a graduate program.

2. To be a candidate for a second undergraduate degree, a student must have the recommendation of the chair of the school concerned and the approval of the Undergraduate Curriculum Committee.

3. To obtain a second undergraduate degree, a student must complete all major required courses for the degree and earn credit for a total of at least 36 credit hours in excess of the requirement for any previous degrees earned.

4. All regulations in section XIII apply to students completing second undergraduate degrees.

G. Minors

1. A student may complete a minor in another academic field while completing the requirements of his or her major degree program.

2. With the approval of the major school, the student should consult an advisor in the minor field, who can inform the student of the requirements for the minor.
3. When a student petitions for a degree, he or she should complete the petition for a minor and have it approved by the minor advisor. The petition for a minor must accompany the petition for the major degree when reviewed for approval by the major school.
4. The minor will be conferred at the same time the degree is conferred.
5. The minor will not be printed on the diploma, but both the degree and minor will be recorded on the student's transcript.
6. Minors may not be conferred retroactively upon students who have graduated.

XIV. Graduate Degrees

A complete description of Institute requirements for the master's and doctoral degrees is given in this catalog in the section titled "Information for Graduate Students." Students desiring to withdraw their name from the rolls of degree candidates must formally withdraw the petition for degree before the deadline specified in section XIII.A.2.

XV. Student Motor Vehicles

Students desiring to operate motor vehicles on campus are subject to all rules set forth by the Georgia Tech motor vehicle regulations.

XVI. Medical Regulations

A. General

1. No student with a contagious disease may stay in a dormitory or fraternity/sorority house, or attend class. Any illness with fever should be considered a contagious disease until checked by a physician. Every student is held individually responsible for immediately reporting such illness to the infirmary.
2. A current Health Information Record and a consent-for-treatment form must be on file with the director of Health Services.

B. Infirmary Regulations

Students must conform to infirmary regulations, as posted in the infirmary, while confined as patients in the infirmary.

XVII. Extracurricular Activities

A. Participation

1. In order to be eligible for participation in extracurricular activities, a student must satisfy the following requirements:
a) be enrolled in a degree program;
b) maintain a schedule with at least six credit hours on a credit basis or be a student in the Cooperative Division on work term; and
c) not be on academic or disciplinary probation.
2. Changes in academic standing that affect eligibility become effective when determined by the Institute at the end of each term (normally the Tuesday following final examination week), except that a student whose academic standing changes from good to probation shall remain eligible through the day preceding the first day of instruction of the following academic term.
3. Any student placed on academic drop/dismissal, review, suspension, or expulsion is immediately ineligible for participation.
4. Participation also requires satisfaction of any additional requirements established by the Student Activities Committee of the Academic Senate.

B. Scheduling of Events

1. During the first week of each term, a schedule of public performances to be sponsored by each student organization must be submitted to the Division of Student Affairs for approval by the Student Academic and Financial Affairs Committee of the Academic Senate.
2. All student organizations must make written application to, and receive permission from, the Division of Student Affairs to hold a social function. The request must be submitted at least one week before the date of the activity, and the permission must be received before making any agreements in connection with the function.
3. In each term, the weekend before final examinations is closed to student-sponsored extracurricular events.

C. Student Organizations

Requirements and standards for chartering a student organization are established by the Student Activities Committee of the Academic Senate and are available from the Division of Student Affairs.

D. Fraternity and Sorority Regulations

1. To be eligible for initiation, a student must be a full-time student not on academic or disciplinary probation.

2. The initiation of any individual must be registered with and approved by the Division of Student Affairs prior to the initiation.
3. The individual must meet all Georgia Tech Interfraternity Council (I.F.C.) or Panhellenic requirements concerning initiation.
4. All fraternities and sororities are subject to the rules established by the Georgia Tech I.F.C./Panhellenic.

E. Intercollegiate Athletics Regulations

1. To be eligible for intercollegiate athletic competition, a student must satisfy the following requirements:
a) be eligible to participate in extracurricular activities, as defined in section XVII.A;
b) be carrying a full-time workload as defined in section VI.A.2;
c) be making satisfactory progress toward a degree; and
d) meet any further requirements of the NCAA or other governing organization; see the athletic director for details.
2. No student may be excused from regularly scheduled classes for athletic practice.
3. No student may participate in more than two sports in intercollegiate competition in any school year, except by permission of the Division of Student Affairs. Being manager or assistant manager is counted as participation within the meaning of this rule.

XVIII. Student Conduct Code

A. General

A student enrolling in the Georgia Institute of Technology assumes an obligation to conduct himself or herself in a manner compatible with the Institute's function as an educational institution. Actions considered inimical to the Institute and subject to discipline fall into the categories of academic and nonacademic misconduct.

B. Academic Honor Code

Article I: Honor Agreement

Having read the Georgia Institute of Technology Academic Honor Code, I understand and accept my responsibility as a member of the Georgia Tech community to uphold the Honor Code at all times. In addition, I understand my options for reporting honor violations as detailed in the code.

Article II: Honor Code

Section I. Statement of Purpose

The members of the Georgia Tech community believe that a fundamental objective of the Institute is to provide the students with a high-quality education while developing in them a sense of ethics and social responsibility. We believe that trust is an integral part of the learning process, and that self-discipline is necessary in this pursuit. We also believe that any instance of dishonesty hurts the entire community. It is with this in mind that we have set forth an Academic Honor Code at Georgia Tech.

Section 2. Objectives

An Honor Code at Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. It specifically aims to accomplish the following:

- Ensure that students, faculty, and administrators understand that the responsibility for upholding academic honesty at Georgia Tech lies with them;
- Prevent any students from gaining an unfair advantage over other students through academic misconduct;
- Ensure that students understand that academic dishonesty is a violation of the profound trust of the entire academic community;
- Clarify what constitutes academic misconduct among students at Georgia Tech and what is expected of them by the Institute, the faculty, and their peers;
- Cultivate an environment at Georgia Tech where academic dishonesty is not tolerated among the students;
- Secure a centralized system of education and awareness of the Honor Code.

Section 3. Student Responsibilities

Students are expected to act according to the highest ethical standards.

The immediate objective of an Honor Code is to prevent any students from gaining an unfair advantage over other students through academic misconduct. For clarification of the definition of student academic misconduct, see section XVIII.C. While these acts constitute assured instances of academic misconduct, other acts of academic misconduct may be defined by the professor.

Students must sign the Honor Agreement affirming their commitment to uphold the Honor Code before becoming a part of the Georgia Tech community. The Honor Agreement may reappear on exams and other assignments to remind students of their responsibilities under the Georgia Institute of Technology Academic Honor Code.

Section 4. Faculty Responsibilities

Faculty members are expected to create an environment where honesty flourishes. In creating this environment, faculty members are expected to do the following:

- Make known to their class as specifically as possible what constitutes appropriate academic conduct as well as what comprises academic misconduct; this includes but is not limited to the use of previously submitted work, collaborative work on homework, etc.;
- Provide copies of old exams or lists of sample questions to the Georgia Tech library for students to review;
- Avoid the re-use of exams;
- Include a paragraph containing information about the Georgia Tech Academic Honor Code on the syllabus for each class they teach; and
- Report instances of academic dishonesty to the Office of the Dean of Students.

In addition to these expectations, it is recognized that faculty have the authority to superimpose their own interpretations on some aspects of academic conduct including, but not limited to the following:

- Old exams for use during open-book exams;
- Contents of formula sheets allowed on exams;
- Use of calculators on exams;
- Collaboration on out-of-class assignments; and
- Use of previously submitted out-of-class assignments.

Article III: Honor System

Section I. Governing Bodies

The Georgia Institute of Technology Academic Honor Code recognizes the present bodies given the power to enforce the academic regulations of the Institute. The Honor Code recognizes the dean of students to be the principal administrator to enforce Institute disciplinary measures as presently specified in section XX.A of the Student Rules and Regulations.

The Honor Code also recognizes the Student Honor Committee as that body given jurisdiction to hear all cases of alleged academic misconduct as currently specified in section XX.B of the Student Rules and Regulations.

Section 2. Reporting Honor Code Violations

In order for an Honor Code to function, members of the Georgia Tech community must not tolerate violations of it by anyone. Community members are at their discretion to use any of three options to report suspected Honor Code violations:

1. A student may simply desire to confront the fellow student with the perceived infraction. While this option is the most likely to enact widespread change in attitude and behavior among students (because the violator would understand that they are violating the trust of their peers and not some abstract body of people), it is still expected that an alleged violator will be reported to the dean of students.
2. A student may choose to approach the professor of the class in which the alleged infraction occurred and seek his or her input on how to proceed. A result of a conference of this type would be the professor's awareness that the alleged violator needs closer monitoring to ascertain reasonable certainty of guilt before being reported to the dean of students.
3. A student may choose to seek the advice of an honor advisor (see Article III, Section 3). Meetings with honor advisors shall address issues of policy and procedure only. Specifics of an individual case are not to be discussed. After a consultation with an honor advisor, a student may choose to submit a formal accusation of academic misconduct to the vice president for Student Services.

Section 3. Student Honor Advisory Council

Students composing the Student Honor Advisory Council are to become well versed in all aspects of the Georgia Institute of Technology Academic Honor Code and the procedures for reporting an honor violation, as well as those procedures for the trying of cases of suspected academic misconduct before the Student Honor Committee. The Council is to act as an information resource to all members of the Georgia Tech community on issues related to the Honor Code.

Complete copies of the Honor Code may be obtained from the Office of the Dean of Students.

C. Academic Misconduct

Academic misconduct is any act that does or could improperly distort student grades or other student academic records. Such acts include but need not be limited to the following:

1. Possessing, using, or exchanging improperly acquired written or verbal information in the preparation of any essay, laboratory report, examination, or other assignment included in an academic course;
2. Substitution for, or unauthorized collaboration with, a student in the commission of academic requirements;
3. Submission of material that is wholly or substantially identical to that created or published by another person or persons, without adequate credit notations indicating the authorship (plagiarism);
4. False claims of performance for work that has been submitted by the claimant;
5. Alteration or insertion of any academic grade or rating so as to obtain unearned academic credit;
6. Deliberate falsification of a written or verbal statement of fact to a member of the faculty so as to obtain unearned academic credit;
7. Forgery, alteration, or misuse of any Institute document relating to the academic status of the student.

D. Nonacademic Misconduct

Nonacademic misconduct includes the following specifically prohibited acts whenever, unless otherwise stated, such acts occur on Institute-owned or controlled property or Institute-related premises:

1. Alcohol abuse, including
a) conspicuous or flagrant possession of alcoholic beverage;
b) intoxication made manifest by boisterousness, rowdiness, obscene or indecent conduct or appearance, or vulgar, profane, lewd, or unbecoming language;
c) disorderly conduct associated with the use of alcoholic beverages.
2. Pushing, unjustifiably striking or physically assaulting, or otherwise intentionally threatening or endangering the person of any member of the faculty, administration, staff, or student body, or any visitor to the campus.
3. Disorderly conduct, including
a) breach of the peace or obstruction or disruption of teaching, research, administration, disciplinary procedure, or other Institute activities, including its public service functions or other authorized activities;
b) refusal to vacate a building, street, sidewalk, driveway, or other facility when directed to do so by any properly identified Institute faculty, administration, or staff personnel while these persons are acting in the performance of their duties;
c) lewd, indecent, or obscene conduct or expression;
d) failure to comply with instructions or directions of any properly identified faculty, administration, or staff personnel while these persons are acting in the performance of their duties.
4. Drug abuse, including the use or possession (without valid medical or dental prescriptions), manufacture, furnishing, sale, or any distribution of any narcotic or dangerous drug controlled by law; this provision is not intended to regulate alcoholic beverages, which are covered in item 1.
5. Unauthorized use of college facilities including
a) unauthorized entry into any Institute building, office, or other facility or remaining in any building after normal closing hours;
b) unauthorized use of any Institute telephone facility or of any other Institute facilities;
c) possessing, using, making, or causing to be made any key for any Institute facility without proper authorization;
d) unauthorized use of another student or faculty member's password to gain access to the computer or computer output. This includes but is not limited to any knowing and willing use of fraudulent means to process computer programs and access computer files.
6. Furnishing false information to any Institute official or offering false statement in any Institute disciplinary hearing.
7. Forgery, alteration, or misuse of any Institute document, record, or identification.
8. Any hazing action that tends to cause or allow physical or mental suffering in connection with rites or ceremonies of induction, initiation, or orientation into Institute life or into the life of any Institute group or organization.
9. Safety violations, including
a) intentional false reporting of a fire or that any explosive device has been placed on Institute property;
b) tampering with fire-fighting equipment, safety devices, or other emergency or safety equipment;
c) setting an unauthorized fire;

d) possession of unauthorized fireworks, firearms, ammunition, or dangerous weapons or materials;
e) unauthorized sale, possession, furnishing, or use of any incendiary device or bomb;
f) use of smoking tobacco, in any form, in facilities or areas posted with "No Smoking" signs or where smoking has been prohibited by any faculty member or other official.
10. Theft and/or unauthorized possession of Institute property or property of a member of the Institute community or campus visitor.
11. Malicious or unauthorized damage or destruction to Institute property or property belonging to any member of the Institute community or campus visitor.
12. Violation of rules governing residence in Institute-owned or controlled property such as dormitories, family housing, fraternities, sororities, and organization housing.
13. Playing of games of skill or chance for money or other items of value.
14. Failure to remit, return, or submit financial obligations, property, or records of the Institute within the time prescribed by the Institute.
15. Knowingly acting in concert with any other person to perform an unlawful act or to violate an Institute regulation or policy.
16. Violations of the Georgia Tech Motor Vehicle Regulations.
17. Violation of the Regents' Statement on Disruptive Behavior, the full text of which is given in section XIX.
18. Repeated violations of the published Rules and Regulations of the Institute, which cumulatively indicate an unwillingness or inability to conform to the Institute standards for student life.
19. Violation of the conduct code, wherever it may occur; violation of the laws of any city, county, state, or the United States, where the violation creates a clear and present danger of material interference with the normal or orderly processes of the Institute or its requirements of appropriate discipline.

XIX. Regents' Statement on Disruptive Behavior

The following is the policy of the Board of Regents regarding disruptive behavior in any institution of the University System. The rights, responsibilities, and prohibitions contained in this statement are incorporated as a part of these regulations.

The Board of Regents of the University System of Georgia reaffirms its policies to fully support freedom of expression by each member of the academic community and to preserve and protect the rights and freedom of its faculty members and students to engage in debate, discussion, peaceful and nondisruptive protests, and dissent. The following statement relates specifically to the problem described below. It does not change or in any way infringe upon the Board's existing policies and practices in support of freedom of expression and action. Rather, it is considered necessary to combat the ultimate effect of irresponsible disruptive and obstructive actions by students and faculty that tend to destroy academic freedom and the institutional structures through which it operates.

In recent years, a new and serious problem has appeared on many college and university campuses in the nation. Some students, faculty members, and others have on occasion engaged in demonstrations, sit-ins, and other activities that have clearly and deliberately interfered with the regular and orderly operation of the institution concerned. Typically, these actions have been the physical occupation of a building or campus area for a protracted period of time or the use or display of verbal or written obscenities involving indecent or disorderly conduct.

These actions have gone beyond all heretofore recognized bounds of meetings for discussion, persuasion, or even protest in that (1) acquiescence to demands of the demonstrators is the condition for dispersal and (2) the reasonable and written directions of institutional officials to disperse have been ignored. Such activities thus have become clearly recognizable as an action of force, operating outside all established channels on the campus, including that of intellectual debate and persuasion, which are at the very heart of education.

The Board of Regents is deeply concerned by this problem. Under the Constitution of the state of Georgia, under all applicable court rulings and in keeping with the tradition of higher education in the United States, the Board is ultimately responsible for the orderly operation of the several institutions of the University System and the preservation of academic freedom in these institutions. The Board cannot and will not divest itself of this responsibility.

Of equal or even greater importance, such action of force as has been described previously destroys the very essence of higher education. This essence is found in the unhampered freedom to study, investigate, write, speak, and debate on any aspect or issue of life. This freedom, which reaches its full flowering on college and university campuses, is an essential part of American democracy, comparable to the jury system or the electoral process.

For these reasons and in order to respond directly and specifically to this new problem, the Board of Regents stipulates that any student, faculty member, administrator, or employee, acting individually or in concert with others, who clearly obstructs, disrupts, or attempts to obstruct or disrupt any teaching, research, administrative, disciplinary, public service activity, or any other activity authorized to be discharged or held on any campus of the University System of Georgia is considered by the Board to have committed an act of gross irresponsibility and shall be subject to disciplinary procedures, possibly resulting in dismissal or termination of employment.

The Board reaffirms its belief that all segments of the academic community are under a strong obligation and have a mutual responsibility to protect the campus community from disorderly, disruptive, or obstructive actions, which interfere with the academic pursuits of teaching, learning, and other campus activities.

The Board of Regents understands that this policy is consistent with resolutions adopted by the American Association of University Professors in April 1968, by the Association of American Colleges in January 1968, and by the executive committee of the Association for Higher Education in March 1968, condemning actions taken to disrupt the operations of institutions of higher education.

XX. Disciplinary Administration

A. Disciplinary Procedures

1. All acts of misconduct (excepting violations of motor vehicle regulations) on the part of students shall be reported to the dean of students, who is designated the principal administrator to enforce Institute disciplinary measures as they pertain to student academic or nonacademic misconduct.
2. The dean of students shall investigate alleged acts of student misconduct. If the investigation indicates that further action is necessary, the dean of Students shall notify the accused in writing. This written notification shall contain a statement of the nature of the alleged or suspected misconduct and state the sections of the conduct code the student is alleged to have violated.
3. The dean of students or the authorized representative will normally confer with the accused student and, at this conference, the student may admit or deny the alleged violation, the student may waive further hearing and appeal(s) in writing and request that the dean of students take appropriate action, or may request a hearing as specified in 4, 5, or 6 below.
4. Cases of academic misconduct will normally be referred to the Student Honor Committee, which shall hear and try cases involving academic misconduct on the part of any student.
5. Cases of serious nonacademic misconduct that may result in suspension or expulsion will normally be referred to the Graduate Judiciary or Undergraduate Judiciary Cabinet, which shall hear and try these cases. This does not preclude possible legal actions by appropriate law enforcement agencies in those cases of nonacademic misconduct in violation of federal, state, or local law.
6. If the case does not involve possible suspension or expulsion, the dean of students ordinarily shall make full disposition of the case except that he or she, at the request of the accused or for good cause, may refer any case of nonacademic misconduct to the Graduate Judiciary or Undergraduate Judiciary Cabinet.
7. Students accused of an act of academic misconduct or nonacademic misconduct are encouraged to notify their parents or guardian of the charges. Parents or guardian will, if requested, be granted a conference with the dean of students prior to the hearing.

8. An accused student will continue to attend classes and required Institute functions until the hearing is held and a decision is rendered. Exceptions to this will be made when the student's presence may create a clear and present danger of materially interfering with the Institute's normal operations or the requirements of appropriate Institute discipline. In such cases, the dean of students may impose temporary protective measures, including interim suspension, pending the hearing; such protective measures, if applied, will be without reasonably avoidable prejudice to the student.

B. Student Honor Committee

1. The Student Honor Committee shall consist of four members of the corps of instruction elected from the Academic Faculty and two undergraduate students with at least junior standing elected by the Undergraduate Student Council and one graduate student elected by the Graduate Student Senate. Student members must have good academic standing and must not be on disciplinary probation. The chairperson shall be elected annually by the committee from among the Academic Faculty members. The secretary shall be appointed by the chairperson.
2. The committee shall hear and try all cases referred to it involving alleged dishonesty in academic matters on the part of students. The decision in the case shall be transmitted to the office or offices responsible for recording it, for notifying the student officially, and for implementing the action.
3. In its distributed minutes and in the annual report of its activities and findings, the committee shall preserve the anonymity of individuals by generalizing the issues involved and the actions taken.

C. Student Judiciary

1. The Graduate Judiciary shall consist of a graduate student chairperson and six graduate student justices. The graduate student justices and chairperson shall be currently enrolled, full-time graduate students in good academic standing and not on disciplinary probation. They are appointed by the graduate student body president and approved by the Graduate Student Senate. The Graduate Judiciary shall normally hear all cases of graduate student nonacademic misconduct in which there is the possibility of suspension or expulsion of the accused student.
2. The Undergraduate Judiciary Cabinet shall consist of an undergraduate student chairperson and 10 undergraduate student justices. The undergraduate student justices and chairperson will be currently enrolled, full-time undergraduate students in good academic standing and not on disciplinary probation. They are appointed by the student body president and approved by the Undergraduate Student Council. The Undergraduate Judiciary Cabinet shall normally hear all cases of undergraduate student nonacademic misconduct in which there is a possibility of suspension or expulsion of the accused student.

D. Procedural Rights of the Accused

Students accused of an act of misconduct and summoned to a hearing before the Student Honor Committee, Graduate Judiciary, or Undergraduate Judiciary Cabinet have the right to:

1. be accompanied by an advisor of their choice;
2. remain silent with no inference of guilt drawn therefrom;
3. question the complainant;
4. present evidence in their behalf;
5. call pertinent witnesses in their behalf;
6. cross examine witnesses;
7. challenge and unseat as many as four student justices in Undergraduate Judiciary Cabinet hearings (the chairperson cannot be struck; a quorum of six student justices and the chairperson must remain);
8. appeal.

E. Hearing Procedures

1. The chairperson of the appropriate hearing body shall set the date, time, and place of the hearing, shall notify the members of the hearing body, and shall summon all principals in the case (defendants and witnesses).
2. The chairperson of the appropriate hearing body shall notify the accused student in writing at least three days in advance of the scheduled hearing. The written notification should, if reasonably possible, be hand delivered; if not reasonably possible, notification should be by registered mail to the student's local address. The written notification should specify

a) the date, time, and place for the hearing;
b) the nature of the alleged or suspected misconduct with which the student is accused, with sufficient particularity to ensure opportunity to prepare for the hearing; and

c) names of witnesses scheduled to appear.
3. Decisions for the hearing body shall be by majority vote. A quorum for the Student Honor Committee shall consist of five members: three faculty members and two students. A quorum for the Undergraduate Judiciary Cabinet shall consist of the chairperson and six justices. A quorum for the Graduate Judiciary shall consist of the chairperson and four justices.
4. Members of the hearing body shall disqualify themselves if their personal involvement in the hearing is of such a nature as to prejudice the case.
5. The hearings of the Student Honor Committee, Graduate Judiciary, and Undergraduate Judiciary Cabinet shall ordinarily be closed except for the accused, the accused's advisor, and those directly involved; exceptions may be made at the discretion of the chairperson. The hearing body may exclude any person who may be reasonably expected to interfere materially with the hearing or who does interfere materially with the hearing. Hearing body deliberations are closed to all but the hearing body members.
6. The hearing body shall make a tape recording and/or summary transcription of the proceedings.
7. The hearing body shall provide a brief written summary of each case with recommendations for appropriate disciplinary action to the dean of students and to the student involved.
8. The dean of students will review the case and recommendations and implement disciplinary action.

F. Disciplinary Measures

For violations of Institute rules and regulations or for acts of student misconduct, academic or nonacademic, the following disciplinary measures may be taken. This list is not exhaustive and may be modified to meet particular circumstances in any case.
1. Expulsion -- permanent severance of the student's relationship with the Institute.
2. Disciplinary suspension -- temporary severance of the student's relationship with the Institute for a specific period of time, though not less than one term.

A student expelled or suspended shall leave the campus and not visit the campus during the period of suspension or expulsion, except when on official school business. To violate this stipulation would adversely affect the student's chances for readmission.

3. Reprimand -- an oral and/or written statement of disapproval issued to the student.
4. Restriction -- exclusion from participation in social activities and loss of identification card privileges.
5. Disciplinary probation -- notice to the student that any further major disciplinary violation may result in suspension or expulsion; may include setting of restrictions and/or issuing a reprimand. A student on disciplinary probation is not in good standing and may not participate in extracurricular activities.
6. Fines.
7. Restitution -- reimbursement for damage to or misappropriation of property; this may take the form of appropriate service or other compensation.
8. Forced withdrawal -- withdrawal from the academic course within which the offense occurred without credit for the course.
9. Change in grade -- grade change for the course in which the offense occurred.

G. Appeal Procedures

1. If accused students or accusers are dissatisfied with the action taken by the dean of students, they may appeal the case in writing to the vice president of student affairs of Georgia Tech within five days after the action about which there is a complaint. Such appeal shall recite all reasons for dissatisfaction with the previous decision.
2. The vice president of student affairs, within five days, shall refer the appeal to the Student Grievance and Appeal Committee. This committee shall review all facts and circumstances connected with the case and within five days shall make its findings and report thereon to the vice president of student affairs. After consideration of the committee's report, the vice president of student affairs within five days shall make a decision that will be final so far as the Institute is concerned.
3. The Student Grievance and Appeal Committee shall consist of three members of the corps of instruction elected from the Academic Senate and two students with at least junior standing elected jointly by the Student Council and the Graduate Senate. The chairperson shall be elected annually by the committee from among the elected Academic Senate members. The secretary shall be appointed by the chairperson.

4. The Board of Regents of the University System of Georgia is the final appellate authority for all cases involving students who have been suspended or expelled. Should aggrieved persons be dissatisfied with the decision of the vice president of student affairs, they may apply to the Board of Regents, without prejudice to their position, for a review of the decision. The application for review shall be submitted in writing to the executive secretary of the Board within a period of 20 days following the decision of the president. This application for review shall state the decision complained of and the redress desired. A review of the Board is not a matter of right but is within the sound discretion of the Board. If the application for review is granted, the Board, or a committee of the Board, shall investigate the matter thoroughly and render its decision thereon within 60 days from the filing date of the application for review or from the date of any hearing that may be held thereon. The decision of the Board shall be final and binding for all purposes.

XXI. Student Academic Grievance Procedures

The procedures set forth here are intended to provide students at the Georgia Institute of Technology a means for setting forth grievances relating to academic matters and grade disputes when the student believes that an instructor has acted unfairly or improperly in assignment of grades. It is not the intention of these procedures to provide a forum for questioning the judgment or grading policies of faculty.

A. Applicability of the Grievance Procedures

1. Subject Matter: These procedures apply to the review of grievances concerning academic matters and grade disputes.
2. Grievant: These procedures shall be the appellate procedures for students at the Georgia Institute of Technology. Students who have pursued a formal grievance procedure or who have pursued informally the resolution of a grievance in their own school, college, or unit and have had that appeal dismissed, may submit the grievance for review under these procedures.

B. Overview of Grievance Process

1. Informal resolution attempted at the school, department, or unit level.
2. Formal resolution sought at the school, department, or unit level.
3. Formal resolution sought at the Institute level: appeal reviewed and, if so determined, heard by the Student Grievance and Appeal Committee.

C. Steps in the Grievance Process (to be followed in the order presented).

1. The student shall attempt to resolve the grievance with the individual faculty member, the department, or the unit involved.
2. If the grievance is not resolved in step C.1. and the student elects to continue the grievance process, the student may request a formal hearing setting forth in writing the complaint and the remedy sought at the school, college, or unit level. Upon receipt of such appeal, the unit director will acknowledge the appeal in writing within seven calendar days, and will expeditiously proceed to constitute an ad hoc appeal committee. The unit director will serve as a nonvoting member of the committee. In addition, the following four committee members will be selected:

- One tenured faculty member from within the unit, selected by the unit director.
- One member of the academic faculty, selected by the student. The student may elect not to select a faculty member; in that case, the committee will consist of three members.
- One member from outside the unit, selected by the Student Grievance and Appeal Committee in consultation with the unit director.
- One member of the academic faculty selected by the faculty member whose action is in question.

This committee will proceed with due haste to examine the merits of the complaint and to render a decision within 30 days. During the proceedings, the student may present any and all evidence that the student deems necessary to support the complaint, except that the committee must agree that the evidence is in some way relevant. Such evidence may consist of documentation and/or testimony, within reason. Both complainant and respondent may be accompanied by advisors; the role of advisor must, however, be restricted to advice. Complainant and respondent must make their own cases before the committee.

Following a hearing and a written decision at the school, college, or unit level, the grievance is presumed to be resolved unless the grievant appeals.

3. The grievant may appeal the decision that has been rendered by the school, college, or unit to the Student Grievance and Appeal Committee.

a) If the Committee, or subset thereof appointed by the chairperson, rules that the procedures are not applicable or that based on the facts stated by the grievant viewed in the light most favorable to the grievant, there is no basis for relief, then the appeal is denied.
b) If the Committee rules that the Institute procedural rules are applicable and that a hearing of the appeal is warranted, the Committee shall initiate a hearing process.
c) If a student wishes to have a grievance outcome reviewed by the Student Grievance and Appeal Committee with a view to a formal hearing, the student shall observe the following requirements:
c.1 The appeal must be in writing. It must state the basis for the grievance and the facts that support it, including a summary of the steps that have already been taken to resolve the grievance, reasons why the student finds the resolutions unfair or unsatisfactory, and a statement of the desired remedy.
c.2 The written appeal must be presented to the chairperson of the Student Grievance and Appeal Committee within 30 days after the student has received notice of a decision from a school, college, or unit.
c.3 The decision as to whether a formal hearing is warranted shall be made available, in writing, to the parties concerned within 30 days after the Committee has received notice of appeal.
c.4 The Committee may alter a deadline specified in these procedures on written timely petition of either party showing a meritorious reason for delay; if the Committee itself needs to extend a deadline, it may do so on its own authority for periods up to 14 calendar days; for longer delays, the Committee must request an extension from the Executive Board of the Institute.
c.5 The determination of the Committee as to whether a hearing is warranted is final.
c.6 The Committee shall develop and, with the approval of the Academic Senate, establish and publish its own rules of procedure for the conduct of formal hearings.
c.7 After receiving testimony and the relevant documents, the Committee shall make a decision within 30 days on the basis of the received material.
c.8 The Committee's decision shall contain finding of fact, the decision arrived at, reasons for the decision, and the criteria or policy applied in reaching the decision.

D. Remedies

1. General: If the Committee finds, after a formal hearing, that a faculty member, a departmental committee, or an administrator of a unit has not acted fairly or properly, it will recommend a remedy. It will seek to find a remedy that can be implemented by those whose cooperation is needed. In the matter of a grade dispute, this must include the faculty member involved in the dispute.
2. Enforcement
a) If any party does not comply with the decision of the Committee, the Committee shall, upon request of any party, seek full compliance through the administrative offices of the Institute through the chief academic officer (CAO).
b) The merits of the dispute shall not be subject to review in the process of enforcement. There shall be strong presumption in favor of the remedy selected by the Committee.
3. Report of a Final Decision: After a final decision has been made in a case, the Committee shall prepare a report setting forth its findings and recommendations for action and present the report to the CAO. A copy of the report shall be presented to the parties concerned and to those persons involved in implementing the Committee's recommendations. All such communications shall be effected in person or by certified mail with a return receipt requested; such receipt will become part of the Institute records of the case.
Grade Changes: In decisions that would result in the changing of a posted grade, the CAO will instruct the unit director to ask the involved faculty member to effect the prescribed grade change, or, if cooperation is not forthcoming, to effect the grade change directly by action of the unit director. Such action shall not be construed as restrictive of the recourses of the faculty member through the usual appeal procedure of the Institute.

Care will be given that no incomplete or inaccurate information pertaining to the grievance is placed in any file; and that all evidence obtained at any stage of the process and all deliberations and proceedings be kept confidential. At the conclusion of each case, the Student Grievance and Appeal Committee shall transmit original or true copies of documents related to the case to the appropriate office of the vice president of student affairs, who shall keep such records securely as Institute records for a period of time specified by Institute statutes.

4. Final Appeal: Appeal of the decision of the Committee to the CAO shall be permitted only for the purposes of procedural review. Such appeal shall be submitted in writing, with copies to the Committee. The CAO will review the findings of the Committee, and, upon judgment that the Committee has failed to follow these procedures or has failed to follow the procedures approved by the Academic Senate for the operation of the Student Grievance and Appeal Committee (XXI.C.3.c.c6), return the case to the Committee for reconsideration, along with description of the perceived error in procedure and a recommendation for its correction.

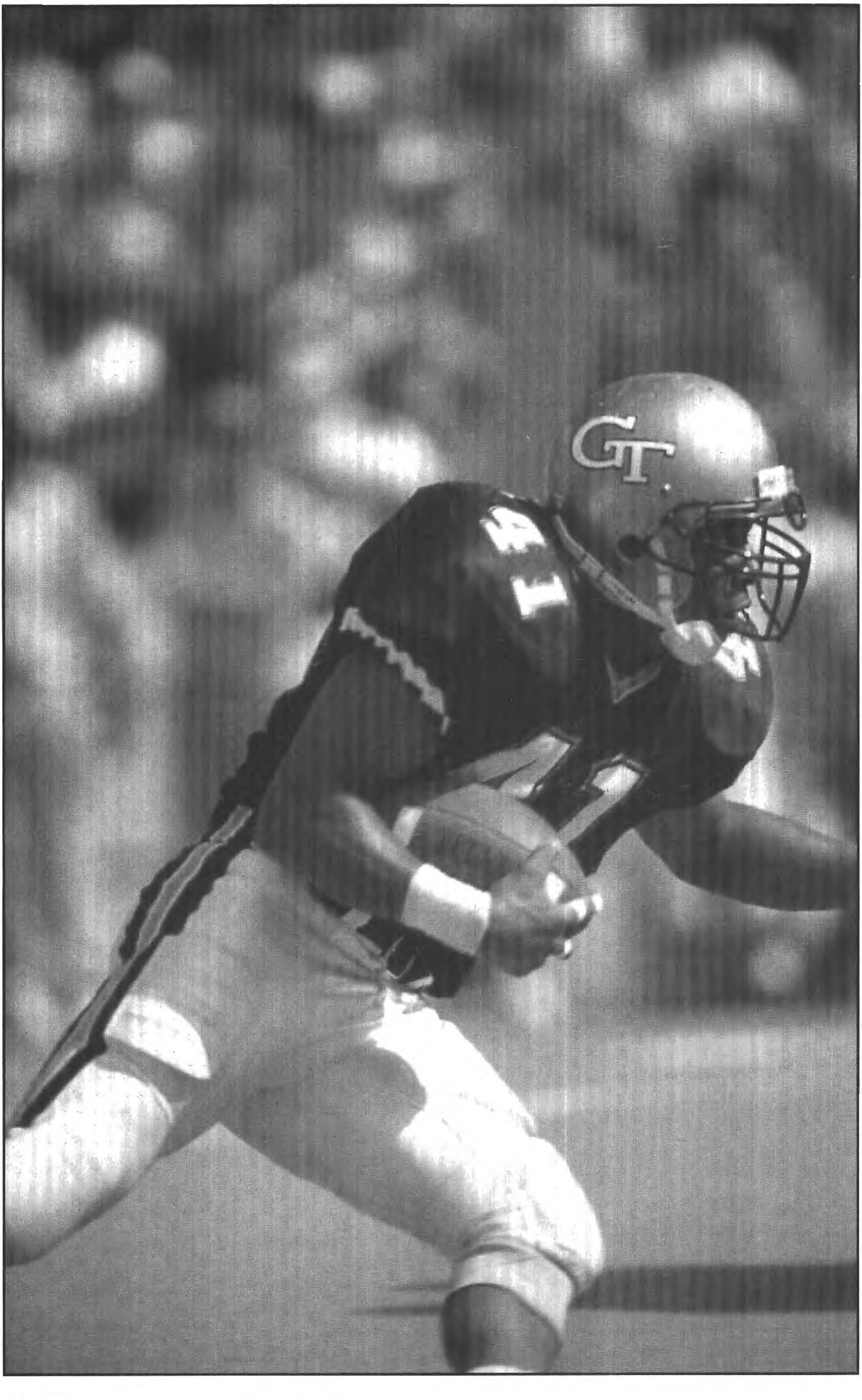
XXII. Exceptions

Where appeals are not otherwise specified, exceptions to these regulations may be made by the appropriate faculty committee upon petition by the student and recommendation of the student's school or department. Blanket exceptions that have the effect of amending these regulations shall be referred to the Academic Senate for approval.

XXIII. Student Bill of Rights

(Adopted by the University System of Georgia Board of Regents.)

1. The right to attend classes during their regularly scheduled time without deviation from such time and without penalty if the student cannot attend instructional hours not institutionally scheduled.
2. The right to consult with an assigned advisor for a reasonable amount of time each term.
3. The right to transfer core curriculum within the University System.
4. The right to consult with faculty outside the classroom time during regularly scheduled office hours or by appointment.
5. The right to reasonable access to campus facilities of which use is required to complete course assignments and objectives.
6. The right to receive each term for each course, a syllabus that outlines course objectives and requirements and to be informed of any changes in these syllabi at the beginning of each term.
7. The right of timely review of lecture and/or reading material before a major examination is administered.
8. The right of each student to receive access to any of his/her records kept by the institution.
9. The right to reasonable access to grading instruments and/or evaluation materials.
10. The right to be informed of the grade appeals process.



Administration, Faculty, and Staff

Administration

Board of Regents

The Georgia Institute of Technology is one of the educational institutions constituting the University System of Georgia. The university system is governed by a 16-member Board of Regents, the members of which are appointed to seven-year terms by the governor of Georgia. The members of the Board of Regents are listed below.

Chancellor of the University System and the Administrative Staff

Chancellor Stephen R. Portch is the chief administrative officer of the University System and the chief executive officer of the Board of Regents. Members of his administrative staff are the following:

Edgar L. Jenkins, chair
Kenneth W. Cannestra, vice chair
Gail S. Weber, secretary to the Board/executive administrative assistant
Lindsay Desrochers, senior vice chancellor, capital resources/treasurer
Arthur N. Dunning, senior vice chancellor, human and external resources
James L. Muyskens, senior vice chancellor, academic affairs/deputy
William K. Chatham, vice chancellor, facilities
Thomas E. Daniel, vice chancellor, external affairs
Barry A. Fullerton, vice chancellor, student services
Dr. E. Michael Staman, vice chancellor, information/instructional technology/CIO
William R. Bowes, associate vice chancellor, fiscal affairs
T. Don Davis, associate vice chancellor, human resources
Cathie M. Hudson, associate vice chancellor, planning and policy analysis
Elizabeth E. Neely, associate vice chancellor, legal affairs
Randall A. Thursby, associate vice chancellor/CIO, information technology
John T. Wolfe Jr., associate vice chancellor, academic affairs
Kris Biesinger, assistant vice chancellor, instructional technology
Kathleen Burk, assistant vice chancellor, Academic Affairs/Director of Regents' Testing
Annie Hunt Burriss, assistant vice chancellor, development and economic services
Corlis Cummings, assistant vice chancellor, legal affairs (contracts)
Linda M. Daniels, assistant vice chancellor, design and construction
Peter J. Hickey, assistant vice chancellor, facilities
Jan Kettlewell, assistant vice chancellor, academic affairs
David M. Morgan, assistant vice chancellor, academic affairs
Elaine Newell, assistant vice chancellor, legal affairs (compliance)

J. Burns Newsome, assistant vice chancellor, legal affairs (prevention)
Arlethia Perry-Johnson, assistant vice chancellor, media and publications
Joseph J. Szutz, assistant vice chancellor, planning
Levy G. Youmans, assistant vice chancellor, management and audit advisory services
Jayne Williams, executive director, virtual library, customer and information services
Mark Demyanek, director, environmental safety
Sarah Farley, director, human resources
John Fleischmann, director, personnel management
Gita Hendessi, director, facilities planning
Jacqueline R. Michael, director, pre-college programs
John Millsaps, director, communications/marketing
Shelley Nickel, budget director
Carole B. Riddle, director, business services
Albertine Walker-Marshall, director, system policy research

The University System of Georgia

Since 1932, all state-operated institutions of higher education in Georgia, including the Georgia Institute of Technology, have sought to accomplish their goals of instruction, public service, and research through their affiliation with the University System of Georgia. Governed by the 16-member constitutional Board of Regents under the administration of the chancellor, the four universities, two regional universities, 13 state universities and senior colleges, and 15 two-year colleges that compose the System retain a high degree of autonomy while cooperating with member institutions within the structure of Board policy. In addition to the formulation and administration of policy, the Board of Regents is responsible for requesting appropriations from the Georgia legislature and for allocating these funds to member institutions.

To provide students in Georgia with quality instruction leading to a variety of degrees, the Board of Regents establishes minimum academic standards, granting to each member institution the prerogative of establishing higher standards. Besides providing a foundation for sound instruction, the Board encourages public service and continuing education programs, including lectures, conferences, short courses, advisory services, extension courses, and teacher education consortiums. The Board also encourages research related to the educational objectives of the institutions and originating in societal need.

Appointed by the governor and confirmed by the Georgia Senate, the members of the Board of Regents—five from the state at large and one from each of the state's 11 congressional districts—serve for seven-year terms; the chancellor, who is not a member of the Board, is chief executive and administrative officer for the Board and the University System. Each institution has as its executive head a president whose election is recommended by the chancellor and approved by the Board.

Member Institutions

Comprehensive and Special Purpose Universities

Athens 30602
University of Georgia
Atlanta 30332
Georgia Institute of Technology
Atlanta 30303
Georgia State University
Augusta 30912
Medical College of Georgia

Regional Universities

Statesboro 30460
Georgia Southern University
Valdosta 31698
Valdosta State University

State Universities and Senior Colleges

Albany 31705
Albany State University
Americus 31709
Georgia Southwestern State University
Augusta 30910
Augusta State University
Carrollton 30118
State University of West Georgia
Columbus 31993
Columbus State University
Dahlonega 30597
North Georgia College and State University
Fort Valley 31030
Fort Valley State University
Marietta 30061
Kennesaw State University

Marietta 30060
Southern Polytechnic State University
Milledgeville 31061
Georgia College and State University
Morrow 30260
Clayton College and State University
Savannah 31406
Armstrong Atlantic State University
Savannah 31404
Savannah State University

Two-year Colleges
Albany 31707
Darton College
Atlanta 30310
Atlanta Metropolitan College
Bainbridge 31717
Bainbridge College
Barnesville 30204
Gordon College
Brunswick 31523
Coastal Georgia Community College
Cochran 31014
Middle Georgia College
Dalton 30720
Dalton State College
Decatur 30089-0601
Georgia Perimeter College
Douglas 31533
South Georgia College
Gainesville 30503
Gainesville College
Macon 31297
Macon State College
Rome 30163
Floyd College
Swainsboro 30401
East Georgia College
Tifton 31793
Abraham Baldwin Agricultural College
Waycross 31501
Waycross College

Board of Regents
University System of Georgia
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Institutional Administration

President
G. Wayne Clough, Ph.D., *president*
Mark J.T. Smith, Ph.D., *executive assistant to the president*
Andrea Ashmore, B.A., *special assistant to the president; director, institute partnerships*
Andrew J. Harris Jr., M.P.A., *special assistant to the president; director, government relations*
Robert T. Harty, M.A., *executive director, institute communications and public affairs*

Provost
Michael E. Thomas, Ph.D., *provost and vice president for academic affairs*

Office of Administration and Finance
Robert K. Thompson, M.B.A., *senior vice president, administration and finance*
Rob Clark, B.S., *director, internal auditing*
Chuck Donbaugh, B.A., *associate vice president for human resources*
Joel E. Hercik, M.B.A., *associate vice president for financial services*
Hal Irvin, Ph.D., *director, management services*
Rosalind Meyers, C.P.A., M.B.A., *associate vice president for auxiliary services*
Randy A. Nordin, J.D., *chief legal advisor, legal affairs*
Charles Rhodes, M.S., *associate vice president for facilities*
Steve Swant, M.A., *associate vice president for budget and planning*
Gordon Wishon, M.S., *associate vice president/ associate vice provost, information technology*

Advanced Technology Development Center
H. Wayne Hodges, B.A., *director*
Jerry T. Wilson, M.S., *associate director, Middle Georgia Technology Development Center*

Auxiliary Services

Rosalind R. Meyers, C.P.A., M.B.A., *associate vice president for auxiliary services*
Glenn Boyett, *director, information technology for auxiliary services*
Vern Johnson, B.S., *director, campus dining*
Dan Morrison, M.A., *acting director, housing*
Blaise Morrisey, M.Ed., M.H.A., *director, student health services*
John Nolte, B.S., *director, parking and transportation services*
James A. Pete, M.B.A., *director, all-campus card office*
Gerald Ritchie, B.A., *director, bookstore*
Terry L. Sichta, M.Ed., *special assistant to the associate vice president for auxiliary services*
Richard Steele, B.ChE., *director, student center*
Jack Vickery, M.P.A., *police chief/parking & transportation services*

College of Architecture

Thomas D. Galloway, Ph.D., *dean*
Thomas N. Debo, P.E., Ph.D., *associate dean*

College of Computing

Peter A. Freeman, Ph.D., *dean and professor*
Richard J. LeBlanc Jr., Ph.D., *associate dean and professor*
Kurt Eiselt, Ph.D., *assistant dean of student services*
Tom Pilsch, M.S., *assistant dean of continuing education*
Vicky Jackson, B.A., *director, administration*
David Leonard, B.S., *director, computer and network services*
Mary Alice Isele, B.A., *director, external affairs*

College of Engineering

Jean-Lou Chameau, Ph.D., *dean*
J. Narl Davidson, Ph.D., *associate dean*
Jack R. Lohmann, Ph.D., *associate dean*
Lytia R. Howard, Ed.D., *assistant dean*
Jane G. Weyant, Ph.D., *assistant dean*
R. Dale Atkins, M.S., *director, continuing engineering education*
Marta H. Garcia, B.A., *director, development*
Robert G. Haley, M.S., *director, special projects*
Elizabeth Ann Minor, M.B.A., *director, finance and personnel*

College of Sciences

Gary B. Schuster, Ph.D., *dean*
Anderson D. Smith, Ph.D., *associate dean*
E. Kent Barefield, Ph.D., *associate dean*
Blythe A. Keller, B.A., *director, development*
Patricia Ledon, *director, finance*
Gerald E. O'Brien, *director, facilities*

Contract Administration

Jildal Diehl Garton, M.S., *associate vice provost for research and general manager, GTRC and GTARC*
G. Duane Hutchinson, M.B.A., *associate director*
R. D. Simpkins, B.S., *manager, contract administration*
Barbara S. Henry, M.P.A., *manager, contracting support division*

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Sabrina T. Hall, M.A., *coordinator*
Kenneth A. Little, M.B.A., *coordinator*
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Patrick J. McKenna, LL.M., *assistant vice president, development; secretary, Georgia Tech Foundation*

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Joseph S. Boland, Ph.D., *director, distance learning*
Diana L. Turner, B.A., *director, continuing education*
Charles Windish, Ph.D., *director, language institute*

DuPree College of Management

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Ann Johnston Scott, M.B.A., *director, M.S.M. program*
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Hope Wilson, M.A., *director, communications*
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Vacant, *director, environmental health and safety*

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George Griffin, B.S., *director, clubs*
Jack C. Henderson, M.S., *director, computing and technical services*
Allison Hickman, B.S., C.P.A., *director, accounting*
Elizabeth Price, B.S., *director, programs and tours*
Jim Shea, B.A., *director, annual giving*
Marilyn J. Somers, M.A., *director, Communications, special projects, and oral history program*
Robb Stanek, M.S., *director, marketing*

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Jeffrey Bourne, M.S., *associate athletic director*
Sterling Brown, M.Ed., *associate athletic director*
Mike Finn, B.A., *director, communications*
Carole E. Moore, Ph.D., *director, academic services*
Ida Neal-Smith, B.S., *assistant athletic director*
Larry New, B.A., *director, Homer Rice Center for Sports Performance*
Rob Olin, B.A., *director, marketing and promotions*
Jay Shoop, M.A., *director, sports medicine*
Jack Thompson, B.A., *associate athletic director*

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Nicolas F. Perez, M.B.A., *director, operations and services*
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Evan Chastain, M.S., *director, institute services*
James W. Cofer, M.S., *director, business development*
Major Gen. George B. Harrison, U.S.A.F. (ret.), *director, research operations*
Janice P. Rogers, *director, administration*

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Susan Paraska, *assistant to associate vice president and associate vice provost, information technology*
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Ron Hutchins, *director, engineering*
John Mullin, *director, operations and engineering*

Barbara Roper, *director, resource management*
Jim O'Connor, *director, enterprise information systems*
Steven Teal, *director, educational technologies*
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Charlene Bayer, Ph.D., *director, Indoor Environment Research Consortium (GTRI)*
Samuel Blankenship, Ph.D., *director, Space Technology and Advanced Research Center (GTRI), and director, Test & Evaluation Research and Education Center (GTRI)*
Terry Blum, Ph.D., *director, DuPree Center for Enterpreneurship & New Venture Development (DuPree College of Management)*
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Michael Burrow, director, *Biomedical Interactive Technology Center (IBB/OIP)*
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David S. Clifton Jr., Ph.D., *general manager, Center for International Standards and Quality (EDI)*
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Steven Danyluk, Ph.D., *co-director, Center for Surface Engineering & Tribology (College of Engineering); and director, Manufacturing Research Center (OIP)*
Charles Eckert, Ph.D., *director, Specialty Separations Center (OIP)*
John E. Endicott, Ph.D., *director, Center for International Strategy, Technology, & Policy (Ivan Allen College)*
T. Lynn Fountain, Ph.D., *associate director, Space Technology and Advanced Research Center (GTRI)*
Charles France, *general manager, Center for International Business Education and Research (EDI)*
Steven French, Ph.D., *director, Center for Geographic Information Systems (College of Architecture and GTRI)*
Robert E. Fulton, Ph.D., *director, CALS Technology Center (College of Engineering)*
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Wayne Hodges, B.A., *director, Advanced Technology Development Center (EDI), and director, Economic Development Center (EDI)*
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Steven Johnson, Ph.D., *director, Composites Education and Research Center (School of Materials Science and Engineering)*
Bernd Kahn, Ph.D., *director, Environmental Resources Center (OIP)*
Roozbeh Kangari, Ph.D., *director, Construction Research Center (College of Architecture)*
Joseph A. Konrelik, Ph.D., *director, Center for Rehabilitation Technology (College of Architecture)*
Uzi Landman, Ph.D., *director, Center for Computational Materials Science (School of Physics)*

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Robert Nerem. Ph.D., *director, Institute for Bioengineering and Biosciences (OIP)*

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Michael W. Parks, *general manager, Center for Manufacturing Information Technology (EDI)*

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Andy Quay, *co-director, Interactive Media Technology Center (OIP)*

Glenn Racine, *director, Software Technology Branch/Army Research Laboratory (ARL)*

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Chris Summers, Ph.D., *director, Phosphor Technology Center of Excellence (GTRI)*

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Ivan Allen College

Kenneth J. Knoespel, Ph.D., *interim dean*
Richard P. Barke, Ph.D., *interim associate dean*
James A. Brannen, B.A., *director, administration and finance*

Libraries

Miriam A. Drake, M.S., *dean/director*
Julia Zimmerman, *associate director*

OMED: Educational Services

S. Gordon Moore Jr., *managing partner/director*
Jacquline Cox, *associate partner, programs office*
Robert Hume, *partner, data compilation/analysis*
Mona Meddin, Ph.D., *partner, instructional innovation*
Letitia Nyandwi, *associate partner, budgets/finance*
Cedric Stallworth, *partner, process control*
Frank Stanley, *associate partner, assessment/projects*

Registrar

Frank E. Roper, M.S.I.E., *registrar*
Annette Satterfield, A.B., *associate registrar*
Marla Jo McIver, B.S., *associate registrar*
R. Scott Verzyl, BSMGT, *assistant registrar*
Debbie S. Williamson, B.A., *assistant registrar*

Research and Graduate Programs

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Maureen Kilroy, M.S., *assistant dean, graduate studies and research*
Keith Oden, M.S., *director, graduate co-op and fellowship programs*
Gail W. Potts, *manager, graduate academic and enrollment services*

Student Affairs

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Gail A. DiSabatino, M.Ed., *dean of students*
Karen Boyd, M.A., *senior associate dean of students; director, student conduct*
Stephanie Ray, M.Ed., *associate dean of students; director, diversity programs and issues*
Daniel Carlson, M.Ed., *assistant dean of students; coordinator, students with disabilities*
William Barnes, M.Ed., *assistant dean of students; director, Greek affairs*
John Hannabach, B.S., *director, career services*
Scott H. Friedman, Ph.D., *director, Counseling Center*
L. William Osher, Ph.D., *director, success programs*
Butch Stanphill, M.Ed., *director, campus recreation*

Student Success Center

Barbara Hall, B.A., *associate vice president, enrollment services*
Paul D. Hurst, M.S., *director, special programs*
T. Jerry McTier, M.Ed., *director, student financial planning and services*
William M. Pouncey, M.B.A., *director, policies and audits*
Deborah Smith, M.Ed., *director, undergraduate admission*

Full-time Academic Faculty and Administrators

As of January 9, 1999

After each name, the highest earned degree and its source are listed. The academic rank is followed by the individual's major assignment. Professional registration is indicated with the state(s) of registration as follows:
P.E. = Professional Engineer
L.S. = Land Surveyor
R.A. = Registered Architect
L.A. = Landscape Architect
P.G. = Professional Geologist

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